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ENGINEERING LIBRARY

The Engineer

TWO SHILLINGS

OCTOBER 16, 1953 28, ESSEX ST., STRAND, LONDON, W.C.2

It is significant that both Littlebrook★ and Dunston★ are fitted with Lockheed hydraulic equipment

its delicacy permits the easy and precise control essential to high efficiency.

From the 'Engineering & Boiler House Review', May 1953

B.E.A. STEAM POWER STATION EFFICIENCIES

The overall average thermal efficiency of the British Electricity Authority's steam power stations (totalling nearly 300) for the calendar year 1952 was 22.61 per cent. compared with 21.79 per cent. in 1951. The improvement in thermal efficiency, 0.82 per cent., represents a saving of over 1,300,000 tons in coal consumption and an economy in working costs of over £3,000,000.

The twenty steam power stations of the Authority which had the highest overall thermal efficiency during 1952 are named with their respective individual efficiencies in the adjoining table.

Three stations, namely, Brunswick Wharf, North Tees "C" and Huncoat, which did not operate throughout the whole year, achieved thermal efficiencies for their periods of commercial operation of 28.41, 26.93, and 26.60 respectively.

The figures show the need for building new power stations and installing new plant in older stations to replace time-expired plant of low efficiency. Well over one-tenth of the Authority's present total output capacity is provided by plant over twenty-five years old.

The British Electricity Authority states that its present plant programmes should make it possible to reach an overall average thermal efficiency of 26 per cent. in 1960.

Station	Thermal efficiency per cent.
★Littlebrook "B," Dartford, Kent	29.95★
★Dunston "B" II, Newcastle-upon-Tyne	29.65★
Portobello H.P., Edinburgh	29.46
Skelton Grange, Leeds	29.19
Bromborough, Cheshire	28.88
Stourport "B," Worcs.	28.84
Battersea "B," London	28.71
Poole, Dorset	28.31
Braehead, Renfrew	27.79
Agecroft H.P., Salford	27.20
Blackwall Point, London	26.66
Clyde's Mill H.P., Glasgow	26.66
Fulham, London	26.63
Cliff Quay, Ipswich	26.63
Stuart Street H.P., Manchester	26.47
Brimsdown "B," H.P., near Enfield	26.41
Hams Hall "B," near Birmingham	26.24
Llynfi, near Bridgend, South Wales	26.23
Staythorpe, Newark	26.18
Croydon "B," Surrey	26.02

Lockheed REGD TRADE MARK

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AUTOMOTIVE PRODUCTS COMPANY LTD., LEAMINGTON SPA

UNIQUE HICO ADVANTAGES

Confirmed by many Repeat Orders!...

Photographs by courtesy of Messrs. Henry Boot & Sons Ltd., Sheffield

HICO Centering consists of lattice girder units of various lengths which, when assembled, are pre-stressed by means of turnbuckles on the lower boom—pre-stressed to ensure a perfectly level span after the load has been added. HICO is light in weight and easy to handle by unskilled labour . . . it is adaptable to any size of span and every type of ceiling . . . its large weight carrying capacity eliminates the need for props and no load is therefore imposed on lower floors . . . it offers outstanding economies on many forms of construction.

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BK48

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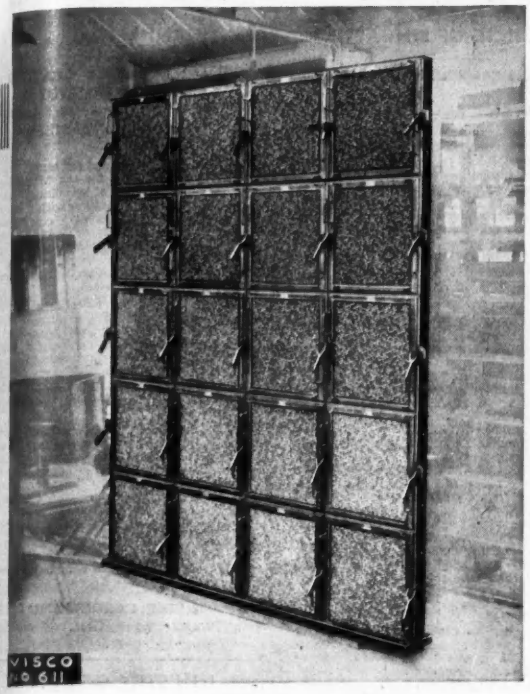

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Tens of thousands of "Visco" Air Filters are in regular use in this country and abroad for the ventilation of buildings, railway coaches, electrical equipment, power stations, etc., and for filtering the intake air of diesel engines, diesel locomotives, electric locomotives and air compressors.

For most purposes, our standard all-metal filter of the oil wetted type is the most efficient and satisfactory. This filter consists of metal cells packed with oil-coated rings or ferrules which break up the air into innumerable thin streams without producing any undue resistance to the air stream. The dust particles being relatively heavier are thrown against the oil-coated surfaces and retained.

The above illustration shows a panel comprising twenty standard cells which forms part of an air filtration plant having a capacity of 4,800,000 c.f.m. supplied to a Government Department.

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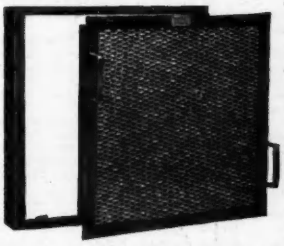
Where an exceptionally high degree of air filtration is required, as in laboratories, food factories, etc., "Visco" two-stage filtration is used. The air is first passed through a set of oil-wetted filters and then through "dry cell" filters.



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For cooling rolling mill motors and other plant operating in very dusty places, as steelworks, "Visco" Patent Rotating Self-Cleaning Filters are in general use.

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VISCO ENGINEERING CO LTD., STAFFORD RD., CROYDON

THE ENGINEER

ESTABLISHED 1856

Vol. 196 No. 5099

OCTOBER 16, 1953

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NOTICE TO READERS

All letters intended for insertion in 'The Engineer' or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications. No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.

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WORDING OF ADVERTISEMENTS: Approximately the first 25 letters of each advertisement are set in heavy type. Advertisers are therefore advised to begin their advertisements with the words they want emphasized.

Advertisements received by Mid-day Tuesday will appear in the issue of Friday the same week. Orders must be accompanied by a remittance.

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PUBLIC APPOINTMENTS

THE UNIVERSITY OF LEEDS

DEPARTMENT OF TEXTILE INDUSTRIES

RESEARCH ASSISTANT

The Council invites applications from Honours Graduates in Physics or Mechanical Engineering for the post of RESEARCH ASSISTANT to the Professor of Wool Textile Engineering for fundamental studies of textile machinery and processes. The appointment, which is renewable, will be for one year in the first instance at a salary of £400 per annum, and the successful candidate will be given an opportunity to read for a higher degree. Applications (three copies), stating age, qualifications and experience, together with the names of three referees, should reach the Registrar, The University, Leeds, 2 (from whom further particulars may be obtained), not later than 2nd November, 1953. E5660

SUNDERLAND EDUCATION COMMITTEE

THE TECHNICAL COLLEGE

Principal: D. A. WRANGHAM, M.Sc. (Lond.), Sen.Wh.Sch., A.C.G.I., D.I.C., M.I.Mech.E.

ASSISTANT LECTURER IN MECHANICAL ENGINEERING

Applications are invited for the post of ASSISTANT LECTURER IN MECHANICAL ENGINEERING in the Engineering Department. Candidates should possess a Degree in Mechanical Engineering and have industrial experience. Some teaching experience is very desirable. The work of the department includes courses for the B.Sc. Degrees of Durham and London Universities and the Higher National Diploma and Certificate in Mechanical Engineering.

Duties to commence as soon as possible.

Salary in accordance with the Burnham Technical Scale, Grade "B," £490 by £25 to £765. Increases above the minimum will be allowed for industrial experience, training and degree.

Forms of application and further particulars may be obtained from the Registrar, Technical College, Sunderland, Co. Durham.

Applications should be returned to the undersigned within two weeks of the appearance of this advertisement.

Canvassing will be a disqualification.

W. THOMPSON,
Director of Education.

Education Offices,
15, John Street,
Sunderland. E5657

ROBERT GORDON'S TECHNICAL COLLEGE

ABERDEEN

LECTURER IN CIVIL ENGINEERING

Applications are invited for the above-mentioned POST. Candidates should possess an Honours Degree in Civil Engineering or have equivalent qualifications, and should have professional or industrial and teaching experience.

The salary scale is £740 by £30 to £1090, with initial placing on the scale according to qualifications and experience.

Further particulars and forms of application may be obtained from the undersigned to whom completed applications should be returned within fourteen days of the appearance of this advertisement.

A. C. WEST,
E5713 Director.

ESSEX

SOUTH-WEST ESSEX TECHNICAL COLLEGE

FOREST ROAD, WALTHAMSTOW, E.17

ASSISTANT, GRADE B

Applications are invited from Graduates, or persons with equivalent qualifications, for appointment as ASSISTANT, Grade B, to teach Mechanical Engineering subjects to Final Degree standard. Salary scale £490 by £25 to £765, plus appropriate graduate, training and London allowances. Recognition given to approved industrial experience in assessing commencing salary.

Applications, stating full details of training, qualifications and experience, to the Clerk to the Governors at the College as soon as possible. E5709

CITY OF BIRMINGHAM WATER DEPARTMENT

CHIEF DRAUGHTSMAN

Applications are invited for the above appointment. Salary scale £625 by £20 to £685 per annum. Post pensionable, medical examination.

The person appointed will be required to supervise the work of the chief engineer's drawing-office, and applicants should have had considerable drawing-office experience, preferably with a local authority or public utility undertaking. Some knowledge of mechanical engineering, building construction or surveying would be an advantage.

Preference will be given to candidates holding a suitable National Certificate.

Applications on forms obtainable from the General Manager and Secretary, Water Department, Council House, Birmingham, 3, P.O. Box 49, must be returned in envelopes endorsed "Chief Draughtsman" not later than 31st October, 1953. Canvassing disqualifies.

October, 1953. E5703

LONDON COUNTY COUNCIL

WANDSWORTH TECHNICAL COLLEGE

ENGINEERING SCIENCE AND ELEMENTARY PHYSICS

Wandsworth Technical College, January, 1954, for Secondary Technical (Boys) School, TEACHER of ENGINEERING SCIENCE AND ELEMENTARY PHYSICS. Graduate or equivalent qualifications and teaching experience desirable. Willingness to assist with games a recommendation. Burnham (P. and S.) salary scale.—Application forms from Secretary at College, Wandsworth High Street, S.W.18, for return by 30th October. (1115) E5697

CIVIL SERVICE COMMISSION

PROFESSIONAL ENGINEERS IN VARIOUS GOVERNMENT DEPARTMENTS

The Civil Service Commissioners invite applications for about 50 pensionable posts in a wide variety of mechanical and electrical engineering duties. Applications will be accepted up to 31st December, 1953.

Candidates must be under 35 on 1st January, 1953, with extension for regular service in H.M. Forces, and up to two years for permanent civil service. For the Post Office they must be at least 21, for the Ministry of Supply and Ministry of Civil Aviation at least 23, and for all other departments at least 25 on that date.

Generally a candidate must possess a University Degree in Engineering or be a Corporate Member of one of the professional institutions—Mechanical Engineers, Electrical Engineers, or Civil Engineers, or have passes in, or exemption from, Sections A and B of the corresponding Associate Membership examinations. Exceptionally candidates of high professional attainment, but without the specified qualifications, may be admitted. For some posts Associate Fellowship of the Royal Aeronautical Society or an Honours Degree in Physics will be accepted.

Salary scale (men in London), £650 (at age 25) to £1000. Starting salary according to age up to £900 at 34. Candidates entering below age 25 will start at salaries varying from £450 at age 21 to £570 at age 24. Prospects of promotion. Salaries o next higher grades are £1000–£1320 and £1375–£1575. Somewhat lower for women and in the provinces.

Further particulars and application forms from Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1, quoting No. S85/53. E5673

MINISTRY OF WORKS

ENGINEERING DRAUGHTSMEN

ENGINEERING DRAUGHTSMEN required in LONDON, at RISLEY (Nr. Warrington), and BEDFORD. Hostel accommodation at Risley, possibly housing at Bedford.

Experience required in one of the following categories :—

MECHANICAL : layout of factory installations, including process plant, steam boilers and steam distribution, pumping, refrigeration and air conditioning.

Development of mechanical plant for a variety of research projects, including rotating machinery, heavy and light mechanisms, servo systems and pressure vessel applications.

HEATING AND/OR VENTILATING : the design of all types of heating and/or ventilating systems and general domestic engineering installations for all classes of buildings.

Salary : London, £396–£628 ; Risley and Bedford, £374–£597, according to age and experience.

Applicants should have British nationality, technical standard of O.N.C. or equivalent, and have apprenticeship or suitable practical experience of at least three years, one in a drawing-office. Promotion and pension prospects.

State age, nationality, details of training, experience, to W.G.10/C.E.2 (B), Ministry of Works, Abell House, John Islip Street, S.W.1. E9907

LONDON TRANSPORT

OFFICE OF ASSISTANT CIVIL ENGINEER (PERMANENT WAY)

TECHNICAL ASSISTANTS

London Transport require TECHNICAL ASSISTANTS, Office of Assistant Civil Engineer (Permanent Way), with drawing-office experience, grounding in civil engineering, knowledge of mathematics, ability to use theodolite and level, and make land surveys. Students of Institution of Civil Engineers preferred, but young graduates without experience considered. Salary rising to £579, with additional payments for certain recognised qualifications. Commencing salary according to qualifications and experience. Medical exam., contributory superannuation scheme after probation.—Applications within 14 days to Staff Officer (F/EV.259), London Transport, 55, Broadway, S.W.1. For acknowledgment enclose addressed envelope. E5715

LONDON ELECTRICITY BOARD

CHIEF ENGINEER

Applications for the position of CHIEF ENGINEER to the London Electricity Board are invited from fully qualified engineers of proved ability in the administration of large engineering organisations.

The commencing salary will be within the provisional range of £2750 and £3250 per annum, but will be settled according to the experience and qualifications of the person appointed

Applications should be made by the 6th November, 1953, to the Chairman of the Board at 46, New Broad Street .E.C.2. E2627

CITY COUNCIL OF SINGAPORE

CITY ENGINEER'S DEPARTMENT

ASSISTANT ENGINEERS

Applications are invited for the following posts of ASSISTANT ENGINEER in the City Engineer's Department, each appointment in the first instance being on a 3 years' agreement, but the appointees could normally expect that, subject to satisfactory service, they would be placed on the permanent establishment on completion of their 3 years' agreements :—

(a) Assistant Engineer (Sewerage).
(b) Assistant Engineer (Roads).
(c) Assistant Engineer (Drainage).
(d) Assistant Engineer, Sewerage (Mechanical).

Applicants for posts (a), (b) and (c) should possess a Degree in Engineering Science recognised by the Institution of Civil Engineers, or Parts A and B of the Institution of Civil Engineers, or Testamur, Institution of Municipal Engineers, and should have had at least 12 years' civil or municipal engineering experience since obtaining professional qualifications, including at least 5 years' experience on the design and construction of large sewerage extension schemes for post (a), roads engineering for post (b), and surface water drainage, flood and river control, bridge and canal construction for post (c).

Applicants for post (d) should possess a Degree in Engineering Science recognised by the Institution of Mechanical Engineers as granting exemption from Parts A and B or have passed Parts A and B of the Institution of Mechanical Engineers, plus :

(i) A recognised engineering apprenticeship.
(ii) Experience with the running and maintenance of pumping machinery, oil engines and compressors.
(iii) Generator First Grade Engineer's Certificate or exempting qualification.

All the four posts are in the scale $630 × A40–1070/Bar/1110 × 40–1150 × 50–1200. The commencing salary for each post will depend on the appointee's age, qualifications and experience. In the case of posts (a), (b) and (c) an applicant having the qualifications and requisite experience stated above would be offered a commencing salary in the range $950–1030 per month. To pass the Bar at $1070 a month the appointees to the posts (a), (b) and (c) must be qualified as an Associate Member of either the Institution of Civil Engineers or Institution of Municipal Engineers.

Expatriation and cost-of-living allowances at such rates as may be approved by the Council from time to time are payable. The present rates are as follows :—

Expatriation allowance : £287 per annum on basic salaries up to $750 a month, £315 per annum on basic salaries between $751 and $870 a month, £343 per annum on basic salaries between $871 and $1000 a month, and £385 per annum on basic salaries between $1001 and $1200 a month.

Cost-of-living allowance : £238 per annum on basic salaries between $630 and $910 a month and £224 per annum on basic salaries between $950 and $1200 a month for a single man ; £337 rising to £382 per annum on basic salaries between $630 and $790 a month, and £385 per annum on basic salaries between $830 and $1200 a month for a married man without children, and £451 rising to £549 per annum on basic salaries between $630 and $830 a month and £560 per annum on basic salaries between $870 and $1200 a month for a married man with one or more children.

For a single man the total emoluments (basic salary, cost-of-living allowance and expatriation allowance) on a basic salary of $630 and $950 a month are £1407 and £1897 per annum respectively ; for a married man without children £1506 and £2058 per annum respectively, and for a married man with one or more children £1620 and £2233 per annum respectively.

$1/– equals 2s. 4d.

Partly furnished quarters provided if available at 6 per cent. of basic salary or housing allowance equivalent to 10 per cent. of basic salary paid in lieu (maximum $120 a month).

Passages : Free passages will be provided for appointee, his wife and his children under the age of 12 years at the date of sailing, subject to a maximum of three full passages.

Leave : One month per year of service plus period of voyage, on satisfactory termination of agreement, or four days a month of resident service plus voyage leave after 48 months if appointed to the permanent establishment and thereafter at shorter periods ; 14 days' local leave per year.

Provident fund : Compulsory provident fund contributions at present 7½ per cent. of salary, to which the Council donate 7½ per cent. rising to 10 per cent. after 10 years' service, 15 per cent. after 15 years' service, and 20 per cent. after 20 years' service. This scheme is under review.

Applications, in duplicate, giving full personal and technical information, with copies of three recent testimonials in duplicate, to Messrs. Allen and Williams (Agents to the City Council), 1, Victoria Street, London, S.W.1, before Tuesday, 10th November, 1953. E2622

THE MOTOR INDUSTRY RESEARCH ASSOCIATION

JUNIOR RESEARCH ENGINEERS AND RESEARCH ASSISTANTS

Applications are invited for the following posts :—

JUNIOR RESEARCH ENGINEERS, good Honours Degree essential ;

(a) For general automobile engineering problems ; experience of experimental stress analysis and/or problems associated with brakes an advantage.

(b) For investigations concerning mechanical properties (in particular fatigue strength) of materials and components.

RESEARCH ASSISTANTS, Higher National Certificate or equivalent qualification essential.

For general automobile engineering problems ; some previous experience in engineering research an advantage, but not essential.

Salaries depend on age and experience. Staff superannuation scheme. Housing accommodation (new houses) will be available for successful applicants.

Reply in writing, giving age, qualifications and experience in detail, to the Director, Motor Industry Research Association, Lindley, Nr. Nuneaton. E2639

GOVERNMENT OF MALTA

JESUITS HILL POWER STATION AND DISTRIBUTION SYSTEM

RESIDENT ENGINEER

Applications are invited for the temporary post of RESIDENT ENGINEER for the Malta Electricity Supply Scheme. The initial installation consists of 3 × 5000kW. turbo-alternators, with 3 × 70,000 lb. hr. oil-fired boilers and ancillary equipment. The distribution system consists of a 11kV. ring main system with underground cables, overhead lines and indoor and outdoor substations, and low voltage distribution, and the adaptation of the existing single phase lines into the new system.

Candidates should be Corporate Members of one of the Senior Engineering Institutions or possess equivalent qualifications, and have had sound training in electrical and mechanical engineering with subsequent practical experience in the installation and operation of steam turbine generating plant, water-tube boilers and ancillary plant and 11kV. and L.V. cables, overhead lines and substation equipment.

The appointment is temporary for a period of two years with the option of extension by one year on an inclusive salary of £2000 per annum. Free passages are provided at the commencement and completion of the contract. Vacation leave at the rate of two-and-half days per completed month of residential service.

Applications, endorsed "Residential Engineer, Malta," stating age, qualifications and experience should be forwarded immediately to the undersigned who will communicate with candidates selected for further consideration.

PREECE, CARDEW AND RIDER,
8 and 10, Queen Anne's Gate,
London, S.W.1. E5662

MINISTRY OF SUPPLY

ATOMIC ENERGY RESEARCH ESTABLISHMENT

PRINCIPAL AND SENIOR SCIENTIFIC OFFICERS

Ministry of Supply, Atomic Energy Research Establishment, Harwell, Berks., requires PRINCIPAL AND SENIOR SCIENTIFIC OFFICERS for fundamental studies of nuclear reactor design involving assessment of metallurgical and materials problems relative to engineering design requirements. Qualifications : 1st or 2nd-class Honours Degree in Mechanical Engineering with metallurgical experience, or 1st or 2nd-class Honours Degree in Metallurgy with engineering experience. Several years' post-graduate research experience required, preferably on materials problems. Appointments, according to age, qualifications and experience, as Principal S.O. (min. age 31), £1033–£1377, or Senior S.O. (min. age 26), £875–£1033. Women somewhat less. Appointments unestablished. F.S.S.U. benefits may be available.—Application forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting C529/53A. E5675

NATIONAL COAL BOARD

WEST MIDLANDS DIVISION

AREA CIVIL ENGINEER

Applications are invited for the post of AREA CIVIL ENGINEER in the No. 1 (North Staffordshire) Area of the West Midlands Division.

The engineer appointed will be responsible for Civil engineering work in connection with major reconstructions.

Applicants must be Corporate Members of the Institution of Civil Engineers and have had experience in the design of heavy foundations and structures and experience in drawing up and administering contracts.

Applications in writing, giving particulars of training and experience, should be addressed to the Divisional Establishment Officer, National Coal Board, West Midlands Division, Himley Hall, near Dudley, Worcs. E5688

THE BRITISH IRON & STEEL RESEARCH ASSOCIATION

GRADUATE PHYSICIST OF ELECTRICAL ENGINEERING

GRADUATE PHYSICIST OF ELECTRICAL ENGINEERING required by the above Association for research and development in connection with industrial process measuring and control instruments. Experience in the development of automatic control mechanisms an advantage. Age up to 27. Starting salary up to £675 p.a., according to age, qualifications and experience. Location of work London. Post is superannuated under the F.S.S.U. Written applications only, quoting "Instruments," to the Personnel Officer, B.I.S.R.A., 11, Park Lane, London, W.1. E5683

WESTMINSTER CITY COUNCIL

CITY ENGINEER AND SURVEYOR

Westminster City Council invites applications from gentlemen with appropriate professional or academic qualifications for the appointment of CITY ENGINEER AND SURVEYOR. Age limit 50 years. Salary, £2700 by £100 to £3000 per annum. J.N.C. conditions of service. Further particulars from Town Clerk, Westminster City Hall, Charing Cross Road, London, W.C.2, to whom applications should be sent before 2nd November, 1953. E5516

THE ENGINEER

OCTOBER 16, 1953

Bi-Centenary of the Royal Society of Arts

ON March 22, 1754, there was held at Rawthmell's Coffee House, Henrietta Street, Covent Garden, "a meeting of some Noblemen, Clergy, Gentlemen and Merchants in order to form a Society for the Encouragement of Arts, Manufactures and Commerce in Great Britain." The company present numbered eleven and included four Fellows of the Royal Society, a watchmaker, a surgeon and a drawing master named William Shipley, who became the first secretary of the Society, which was subsequently named the Royal Society of Arts, and which will celebrate its bicentenary in March, 1954. Eight years after its formation the Society's membership had exceeded the 2000 mark. The Society was incorporated by Charter on June 10, 1847, and its membership throughout the world is to-day about 6000. Recently, H.R.H. The Duke of Edinburgh has honoured the Society by becoming its president, and at an extraordinary meeting of the council, held at Buckingham Palace last July, it was resolved that the bicentenary "be suitably commemorated in the year 1954." A provisional programme of the celebrations has now been issued. They will begin on Monday, March 22nd, with a commemorative service in the Church of St. Martin-in-the-Fields, Trafalgar Square, at which the sermon will be preached by the Bishop of Peterborough, one of whose predecessors in office was a founder-member of the Society. In the afternoon of March 22nd, at the Society's house in John Adam Street, Adelphi, congratulatory addresses will be presented by kindred bodies and an address will be delivered by the Earl of Radnor, chairman of the council. On the three succeeding days special lectures on the arts, manufactures and commerce from 1754 to 1954 will be given, and on Friday, March 26th, there is to be a banquet at the Savoy Hotel. Later in the year, in June or July, there will be a reception at St. James's Palace, by gracious permission of Her Majesty the Queen, who is Patron of the Society.

Institution of Production Engineers

THERE was a large attendance of members and guests at the annual dinner of the Institution of Production Engineers, which was held last Friday evening at Guildhall, London, with the president, Mr. Walter Puckey, in the chair. The company was honoured by the presence of the Lord Mayor of London, Sir Rupert De la Bere, K.C.V.O. Sir Rowland Smith proposed the toast of "The Lord Mayor, the Sheriffs and the Corporation of London," and, in a brief reply, Sir Rupert made reference to the employment of older folk in industry. He said that to-day the country needed every skilled man it could get. He agreed that it was not possible in this matter to lay down hard and fast rules for any industry, but he believed most sincerely that every endeavour should be made to employ all the skilled men who were willing to work, even if they had reached a certain age. There were some magnificent craftsmen in this country and full use ought to be made of them. The toast of "The Guests" was proposed by the president, and replied to by Viscount Waverley, P.C., who said that it was on production that the maintenance of our economic life as a nation was absolutely dependent. There were several essential factors which entered into the process of production. They included research and development, with problems of design coming in between. All those factors, Lord Waverley continued, had to be kept in balance, with the most economic distribution of resources between the different stages. The final toast was that of "Mutual Security," which was proposed by Mr. Harold Burke, chairman of the Institution's council, and acknowledged by Mr. Lincoln Gordon, Minister for Economic Affairs at the United States Embassy. During the proceedings the Lord Mayor presented Institution medals to Dr. J. D. Jevons and Mr. A. Cameron, the Hutchison Memorial award to Mr. J. E. Poulter, and the Institution prize to Mr. W. E. Simpson.

Retirement of Sir John Hacking

WE learn from the British Electricity Authority that Sir John Hacking has decided to relinquish his appointment as Deputy Chairman (Operations) of the Authority on December 16, 1953, at the age of sixty-five. Sir John, who was knighted in the New Year's Honours, 1949, has been Deputy Chairman (Operations) of the Authority since its formation on April 1, 1948, after serving as a member of the Organisation Planning Committee set up in August, 1947, to prepare for the transfer of the electricity supply industry to public ownership. He was born at Burnley, Lancs, and after an apprenticeship with a firm of motor manufacturers in Leeds, from 1905 to 1908, while he worked as an evening student at Leeds Technical Institute and at Leeds University, he joined the staff of the North Eastern Electric Supply Company, Ltd., as a junior assistant. Two years later he was posted to one of the company's waste heat stations and later he became assistant district engineer in Sunderland and Newcastle, where he gained some eighteen months' experience in the company's construction department as assistant engineer. In 1913, Sir John left the North Eastern Electric Supply Company, and joined the consulting engineers, Messrs. Merz and McLellan, with whom he gained varied experience for more than twenty years: from 1913 to 1915 he worked in Newcastle in connection with Argentine railway electrification schemes, and then he went to the Argentine as assistant to the firm's representative, supervising the construction work in connection with the electrification of the Central Argentine Railway and the Buenos Ayres Western Railway. Both schemes involved a power station, substations, track equipment and rolling stock. Early in 1923 he returned to England and for two years he was chief assistant in the traction department in the London office of Messrs. Merz and McLellan. He then became the firm's liaison officer for its overseas' contracts and visited the U.S.A., South Africa, in connection with the Natal main line railway, and Bombay, in connection with the electrification of the Great India Peninsula Railway and the Bombay Baroda and Central India Railway. On behalf of his firm he supervised the construction of the electricity grid in Mid-East and North-East England from 1929 to 1933. Then he visited India again and later in the year he became head of the electrical department of Messrs. Merz and McLellan in Newcastle. Sir John joined the Central Electricity Board in 1934 as deputy chief engineer and was appointed chief engineer as from August 1, 1944. After having served on the council of the Institution of Electrical Engineers since 1943, he was elected vice-president in 1946 and president in 1952. He was the Faraday Lecturer in 1947. In the summer of 1948 he was appointed a member of the Scientific Advisory Council set up to advise the Minister of Fuel and Power on new scientific knowledge and developments. In April, 1949, Sir John led a delegation to the United States and Canada to examine and discuss the practices of selected electricity utility companies in the generation and transmission of electricity and tariffs. He was elected president of the British Electrical and Allied Industries Research Association in April, 1953, and is a vice-president of the British National Committee of the World Power Conference.

Disposal of Road Haulage Units

IT has been announced by the British Transport Commission that it proposes, with the approval of the Road Haulage Disposal Board, to offer for sale some 1500 road transport units comprising about 10,000 road haulage vehicles. This is the first step towards the disposal of road haulage units following the Transport Act of 1953, and disposal of this group of units is expected to be concluded by the end of April next. The units will be offered in three monthly schedules, each comprising some 3300 vehicles, and the vehicles in each schedule will be spread geographically over different parts of England, Scotland and Wales. More than 2000 of the vehicles will be offered for sale in small units of one, two, three or four vehicles, and no unit will include more than fifty vehicles. Operational premises will be included with about half of the units to be sold. Under the time-table which has been prepared public advertisements inviting traders will be published in November, December and January next for the respective schedules and the completion of transfer of the units will take place in the following March and early and late in April. In order to expedite the work of disposal stores held on stock account will be excluded from the units, but purchasers will have an opportunity to buy reasonable quantities of stores at agreed prices. When this announcement was made, Sir Malcom Trustram Eve, the chairman of the disposal board, pointed out that, in addition to these 10,000 vehicles, a large number of other vehicles and properties will be offered as "going concerns" during the first half of 1954 through the sale of share capital of companies. No precise number of vehicles could as yet be put into this latter category, but, said Sir Malcom, the board hoped that a fairly high proportion of the total of 32,000 vehicles to be sold would have changed hands by the end of May next.

Fenchurch Street–Southend Railway Electrification

THE Eastern Region of British Railways has announced this week some details about the preliminary engineering works required for the proposed electrification of the railway lines from Fenchurch Street, London, to Tilbury, Southend (Central), and Sfioeburyness. These works are expected to involve an expenditure of about £250,000. They include the reconstruction of Barking station, track rearrangement with a fly-over, signalling alterations to improve peak-hour working, and the construction of a large new marshalling yard. Two of the platforms at Fenchurch Street station are to be extended to take full-length trains for Southend, and the up platform at East Stepney station is to be lengthened and the curves through the station eased to permit faster running. At Leigh-on-Sea a new up line and platform are to be built and the present up line is to be converted for two-way working. The programme also includes signalling rearrangement on various parts of the line, and the reconstruction of two platforms at Southend (Central) station. To permit better working on the Tilbury line, running loops are to be constructed on the up side between Purfleet and Rainham, and on the down side between Thurrock Junction and Grays.

North of Scotland Hydro-Electric Schemes

No. V—SOME SCHEMES FOR LOCAL SUPPLY*

One aspect of the hydro-electric developments which have been in progress in Scotland since the war concerns the construction of small schemes, in isolated areas, for the production of electrical power to meet local demands. The North of Scotland Hydro-Electric Board's various schemes in this category are described hereunder.

THE hydro-electric development of the Highlands of Scotland has been undertaken against an unusual background of economic conditions. In our "Introductory Survey," which formed the first article in this series, an account was given of the events leading to the formation of the North of Scotland Hydro-Electric Board, and of the basic recommendation of the Cooper Committee, namely, that Highland demands for power should have priority, and that surplus power should be sold to subsidise the uneconomic distribution of electricity in the Highlands.

As a result of this policy, the Board installed a number of diesel generating sets in various Highland centres, soon after its formation. Thus it brought electricity to

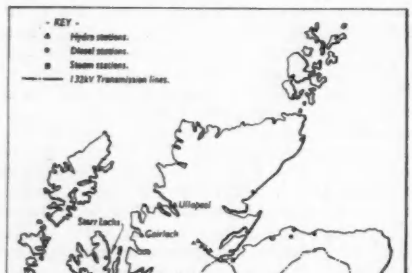


Fig. 1—132kV Transmission Lines and Local Supply Schemes

many areas at the earliest possible opportunity. The more permanent aim, however, was to supply power to such areas from hydro-electric schemes, and this has to a large extent already been achieved.

Whilst these small schemes for local supply may not possess the technical interest of the Board's major schemes, there are still many points of engineering interest in their design and construction upon which we will attempt to concentrate in the ensuing description. The table below gives the principal particulars of the schemes, primarily for local supply, either completed by the Board or under construction at present. The Morar and Lochalsh schemes were the first two to be completed by the Board and were briefly described in the first article in this series, so they will not be referred to again here.

* No. I, "An Introductory Survey," appeared on July 14, 1950; No. II, "The Loch Sloy Project," July 21-August 4, 1950; No. III, "The Fannich Project," June 8–15, 1951; and No. IV, "The Mullardoch-Fasnakyle-Affric Project," April 11–25, 1952.

There are also two other schemes—Gaur, which was officially opened in June of this year and is practically complete, and Allt-na-Lairige, where work has not yet started, each with an annual output of some 17,000,000 units. They are not described here, as their power will go to the Highland grid to supplement the output from the major schemes.

Two further local schemes—Kilmelfort, in Western Argyll, where contracts have just been placed, and Mucomir, in Inverness-shire, which has yet to be approved by Parliament, have been promoted, but work on them has not yet been started. The most important of the local schemes is, therefore, the Cowal scheme, which will be described first.

These local schemes have in common an undue burden of cost for the distribution of power. Nevertheless, their construction is considered by the Board well worth while, and it has been successful in that a high proportion of possible consumers have taken the opportunity of having an electricity supply, as each new scheme is brought into operation. The position of each of these schemes is indicated in Fig. 1, which also shows the extent of the Highland grid connecting the Board's major schemes.

The Cowal Scheme

For a number of years electricity was supplied to the Cowal district of Argyllshire and the islands of Bute and Cumbrae from diesel-electric generating stations at Dunoon, Rothesay and Millport. With the commissioning of the Cowal hydro-electric scheme in 1951, however, hydro-electric power became available, and with two turbo-alternator sets in operation at Loch Striven the diesel stations were relegated to standby and peak load duty. The area served by the scheme is an isolated one, about 500 square miles in extent with a population of about 30,000. The distribution system is not in this case completely isolated from the grid, for there is a 33kV line connecting the Clachan power station of the Glen Shira scheme with the Cowal power station. The Glen Shira scheme is to the north of the area served by the Cowal scheme, and most of its power will normally be transmitted by a high-voltage line to the grid substation at Inveruglas, which also serves Loch Sloy power station, but a certain amount of power may be imported to the Cowal area.

The Cowal scheme, however, is at present able to meet all but the heaviest peak load demands of the area. Its general outline is shown in Fig. 2, from which it may be seen that it consists of a reservoir, formed by two dams and supplied partly by catchwater aqueducts and a diversion tunnel, and a penstock leading to the power station beside Loch Striven. The principal data of the scheme are given in the table.

The reservoir has been formed in the catchment of the River Tarsan by the construction of a gravity buttress dam with a maximum height of 90ft and an overall length of 1200ft, and a secondary, rock-fill dam, known as the Col dam, built at the crest of the catchment between Glen Tarsan and Glen Lean. The natural catchment of the Tarsan above the dam is 3·82 square miles in extent; 2·95 square miles have been added by diverting water from the upper part of Glen Lean in open aqueducts (the southern aqueducts in Fig. 2) to a point close to the subsidiary dam, and a further 7·75 square miles to the north of Glen Tarsan by a tunnel aqueduct from the Garvie and Balliemore burns. The open aqueducts total just over 15,000ft in length, and consist generally of dished trapezoidal channels lined with concrete with water depths up to 2ft 3in; a bituminous coating is provided to protect the concrete from the acidic waters. The tunnel is 17,600ft in length; it has been driven through rock and is unlined, with a horseshoe cross section with a maximum height of 6ft 7in. A point of interest about the open aqueducts is that, in Glen Lean, the landowner of the land below the Glen Lean aqueducts has regarded the improvement in conditions to be such that, with normal field drainage, what was formerly marsh land is now suitable for grazing. The reservoir works have also involved a road diversion, a 10ft road 7000ft in length, the greater part of which lies between the Col and Glen Tarsan dams.

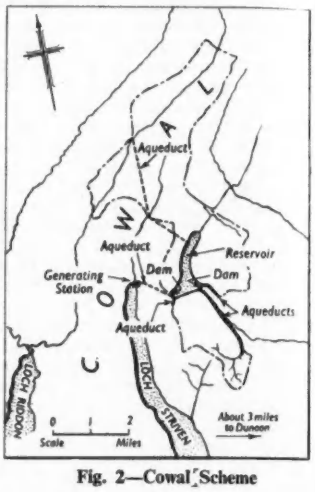


Fig. 2—Cowal Scheme

The rock encountered in the area of the scheme is mainly schistose grit or mica schist, sometimes much contorted and with frequent shatter planes and seams filled with silty clay. These seams were met with both in the open excavations and in the tunnels. Faces

Scottish Hydro-Electric Schemes for Local Supply

Scheme	Estimated annual output, kWh × 10^6	Installed capacity, kW	Gross head, feet	Catchment area, square miles	Average annual rainfall, inches	Year of completion
Morar	2	750	16	65	100	1948
Lochalsh	4	1250	490	7·3	68	1948
Gairloch	4	1250	185	13	76	1951
Lussa	8·5	2400	380	12·6	67	1952
Cowal	14	6000	403	14·5	80	1951
Storr Lochs	3·5	1900	447	5·2	79	1952
Loch Dubh	4	900	513	5·1	62	—

exposed by excavation were often soft and disintegrated in the open air, while blasting tended to dislodge large fragments already cut by clay seams.

The capacity of the Glen Tarsan reservoir was originally to have been 400 million cubic feet, and this figure was increased to 435 million cubic feet by raising the spillweir

carried out, and pressure relief drains lead into the spaces between the buttresses. Generally, derricks were used to place the concrete of the dam and to serve the erection of shutters. Aggregate was brought initially from Arran and a small jetty was built in Loch Striven to handle it, but latterly fine aggregate came from Loch Riddon and

in-situ reinforced concrete piles. The building has a steel framework with harled brick walls and slated roof.

The machines consist of two 3000kW, 0·85 p.f., 600 r.p.m., horizontal-shaft Francis turbo-alternators generating at 3·3kV. The maximum gross head varies between 403ft and 336ft, averaging 380ft. The turbines

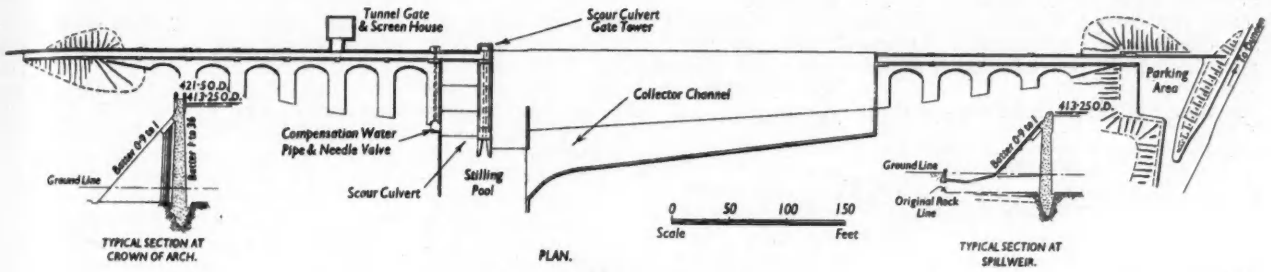


Fig. 3—Glen Tarsan Dam

level from 410·0, as originally intended, to 413·25ft O.D. The total storage has thus been increased from 14½ per cent of the annual output to 15·8 per cent. The main dam is shown in cross section in Fig. 3. The general similarity with the Loch Sloy dam may be noted, but in this case the buttresses are relatively more slender and widely spaced, the height being in the region of half of that of the Loch Sloy dam. The provisions for water control incorporated in the dam are the spillway, a scour culvert (6ft by 4ft in section, controlled by an upstream sluice gate) and a 12in diameter pipe controlled by a needle valve at its downstream end, the needle valve being designed to take the continuous flow of compensation water while any freshets will be delivered by the scour culvert. The intake to the power station is controlled from a reinforced concrete valve tower built just upstream of the dam as a separate structure ; the diversion works then lead off under the right bank, clear of the dam itself.

Each of the buttresses of the dam was concreted as a single block, the concrete poured in steps, keeping the steps highest at the downstream edge of each buttress and with construction joints between the 4ft lifts, sloping down towards the upstream face. The gaps between the buttresses were sealed after a twelve-week interval in much the same way as at the Loch Sloy dam. The shuttering for the arches at the top of the dam was supported from steel joists fitted into pockets in the dam.

As originally designed, the spillway was to be built over the two central bays of the dam, with a depth of 5ft between its crest and the footbridge above it. However, when it was decided to raise the dam by 3·25ft, as mentioned above, the spillweir was extended to cover seven further bays, making nine bays in all. A side spillway channel was built to lead into the central stilling pool, as Fig. 3 indicates. The spillway has been formed between the buttresses of the dam by spanning the gap horizontally with rolled steel joists. These joists are carried in pockets let into the buttresses at each side ; they each carry a bearing plate welded on to their top flanges and are encased in "gunite." Hollow precast reinforced concrete members span between the joists in the inclined direction, forming the surface of the spillway, which was completed with a light mesh of reinforcement and a covering of "gunite."

The cut-off trench below Glen Tarsan dam is 26ft in depth at its deepest point. Grouting, up to 100 lb per square inch, was

coarse aggregate from Dumbuck Quarry, Dunbartonshire. The total quantity of concrete in the dam is in the region of 50,000 cubic yards. Glen Tarsan dam is shown in Fig. 4, and details of the subsidiary dam, the Col dam, may be seen in the cross section, Fig. 5.

Loch Striven Power Station

From the valve tower at Glen Tarsan dam, the pressure conduit works to Loch Striven power station consist first of a short length of cut-and-cover tunnel of reinforced concrete, and then the principal tunnel, 4044ft long, 6ft 3in in height, and of horse-shoe cross section, lined with concrete. The surge shaft is 15ft in diameter and 134ft high, and is situated 250ft upstream from the Loch Striven portal. A single welded steel pipeline, 1030ft in length and 54in in internal diameter (the first 132ft was laid in tunnel and concreted solidly into place), leads from the surge shaft to the power station and bifurcates close to the latter into two 36in diameter pipes, each serving one of the turbines.

Loch Striven is a sea loch, and the power station has been built on the saltings beside it, with the tail-race channel at about half-tide level. The machine hall is 85ft by 35ft and the two generators are carried on reinforced concrete bases, both these bases and the building being supported on short

are designed to give their best efficiency at a net head of 365ft. They are of standard design with mixed cast and welded steel construction and runners of cast steel. Inlet valves of the hydraulically operated sluice type, 3ft in diameter, are provided, together with relief valves. The alternators have open circuit cooling and are mounted on base plates with two bearings, one of which is combined with a Michell thrust bearing. The turbine runners are overhung on one end of the alternator rotor shafts, the other end driving the exciter, to which is also coupled the permanent magnet generator supplying the turbine governor.

The essential auxiliary equipment required for machines of this kind and capacity is extremely simple. At this station it comprises for each machine merely an electrically driven governor oil pumping set with pressure reservoir and oil tank, for supplying the hydraulic power to the turbine governor and servo motor. There is also a bearing lubricating oil pump which is belt driven from the alternator shaft. Water for cooling the bearing oil is taken from each pipeline through a pressure-reducing valve and discharged direct to the tail-race. The electrical supply for the auxiliary plant and for lighting and heating is obtained from 25kVA unit auxiliary transformers direct coupled to each alternator, or is tapped from one of the outgoing transmission lines to Dunoon.

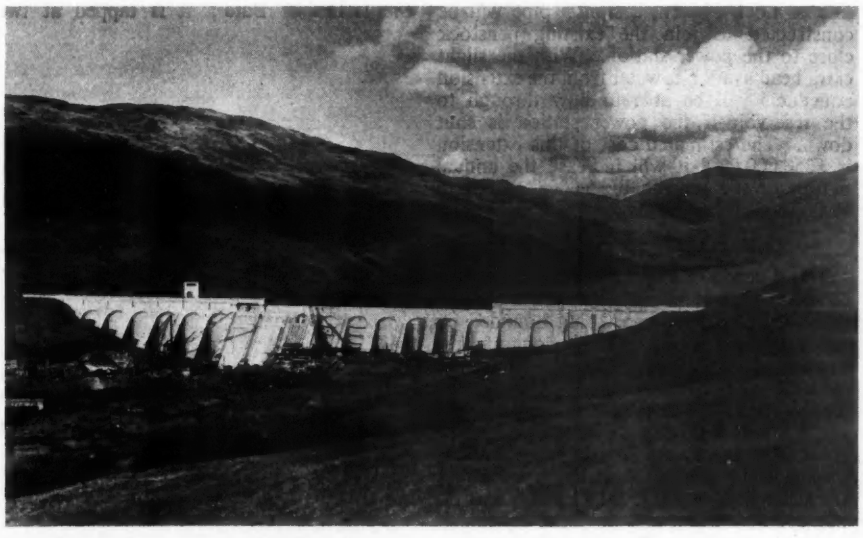


Fig. 4—Glen Tarsan Dam under Construction

A small 100 A-h, 50V battery is provided for operation of the controls, alarms, switchgear closing and tripping, indicator lights and emergency lighting.

The machines are started and stopped manually in the station by an attendant who has general duties in connection with the whole works, and is thus not always in the station. An alarm bell is installed in his cottage to call him to the station in the event of any emergency occurring when he is not actually present in the station. A cross section through the power station is shown in Fig. 6.

The voltage of the machines is stepped up from 3·3kV to 22kV by 3·5MVA transformers direct coupled to the alternators and to 22kV busbars in an indoor switchhouse which is built as an annexe to the station. The busbars supply two 22kV feeders to Rothesay and two to Dunoon. It was found that sufficient water storage could not be economically provided to enable the station to give the firm kilowatthours ultimately needed to meet the estimated demand throughout the whole year. The deficiency will be met by the 33kV connection to the Board's 132kV system at Clachan, referred to above.

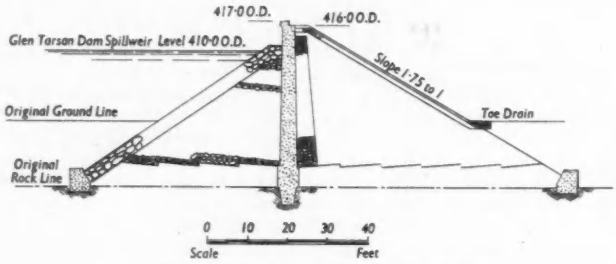


Fig. 5—Cross Section of the Col Dam

Cowal Extension Scheme

An extension to the Cowal scheme as described above was confirmed by the Secretary of State for Scotland early last year, and work on it will be begun shortly. It consists of the construction of aqueducts to divert waters from about 6 square miles of the catchments of various small streams flowing mainly into the head of Loch Riddon. The area involved is on the opposite side of Loch Striven from the power station, and the aqueducts will be about 500ft above sea level. From the high ground on the west side of Loch Striven, a siphon pipe will be constructed to join the existing penstock close to the power station. With the slight extra head available, water from the extension aqueducts will be able to flow through to the reservoir if the power station is shut down. The estimated cost of this extension is £350,000 and it will increase the annual output of the scheme by 5,000,000kWh to 19,000,000kWh.

Cowal Distribution Scheme

The Board's Cowal distribution scheme covers the mainland area between the Kyles of Bute and Loch Fyne, being bounded on the east by the shores of Loch Long and the Firth of Clyde. It also includes the Islands of Bute and Great Cumbrae. The main load centres are Dunoon, Rothesay, Tighnabruaich and Millport, where the population substantially increases during the holiday season. The resident population served by the scheme is 29,600 (1931 Census), and the number of existing and potential consumers including those in Dunoon and Rothesay, where supply has been developed for some years, is estimated to be 10,950. Before the construction of this distribution scheme, electricity supply was restricted to the towns of Dunoon and Rothesay, each of which operated a diesel generating station, as mentioned previously, but there was no interconnection between them. The Board has constructed some 200 miles of high-voltage line and 30 miles of low-voltage line in the area.

The distribution system is centred on the Striven power station. Duplicate 0·05 square inch, 22kV overhead lines on wooden poles connect Striven power station with each of the Dunoon and Rothesay diesel stations where directly connected 2MVA transformers fitted with on-load tap-changing gear provide a connection with the local network. At Dunoon this operates at 6·6kV, but at Rothesay the network was recently changed over to 11kV. From Striven power station a single circuit 0·075 square inch, 33kV line runs northwards through the hills to Newton on the shore of Loch Fyne and then follows the shore to the head of the Loch, where it will shortly be connected into the Board's new hydro-electric station at Clachan. This line, besides acting as a distributor for the supplies in North Cowal provides the whole scheme with a connection at Clachan to the 132kV grid. Through the 33kV busbars at Clachan a link is also established with the Board's Lussa hydro-electric station and with Campbeltown in Kintyre.

Though the 22kV lines between Dunoon and Rothesay are tapped to supply the needs of consumers along their routes the general distribution in the area is carried out at 11kV and is mainly centred on Rothesay power station. The voltage of 22kV for the main lines to Dunoon and Rothesay was selected primarily on account of the need for the maximum economy of expenditure in the early stages of this scheme, but the growth of load at Rothesay is now such that the Board has decided it is necessary to increase the voltage of the two Rothesay lines to 33kV ; this work is in hand.

A 0·05 square inch, 11kV ring main caters for the load at the southern end of the Island of Bute ; it is tapped at two points to supply Millport on Great Cumbrae, the connections being made by submarine cables laid on the bed of the Firth of Clyde, which are referred to again later. The Bute ring is sectioned in such a way that the supply to Millport can be afforded either from the east or from the west side of the ring.

A second 11kV ring covers the middle and western portions of the Island of Bute ; from it a spur extends northwards to Kilmichael where a submarine cable crosses the Kyles of Bute to give supplies in the Tighnabruaich area. An 11kV rural overhead line, mainly of single-phase construction, with spurs, runs from Auchenlochan through Kilfinan to Otter Ferry and Largiemore. An alternative supply is given to Tighnabruaich by a tapping at Rudhbodach, off one of the Striven–Rothesay feeders, whence a short 11kV line runs over the hills to Rudha Ban, the connection being completed by a second submarine cable to Port Driseach. The Glendaruel district is supplied by an 11kV line fed from a second 22/11kV tapping off one of the Striven–Rothesay feeders at Stronafian while Colintraive and consumers along the north shore of the Kyles to Southhall are supplied by another spur at 22kV.

The 33kV and 22kV lines have " wishbone " cross arms, as has the 11kV line on the east side of Bute. All the remaining lines are of rural construction as recommended in B.S. 1320. The conductor material is cadmium copper with the exception of the 33kV line in North Cowal, which is of h.d. stranded copper. All the rural lines have 3/0·093 stranded cadmium copper conductor (0·017 square inch copper equivalent).

The number of substations in the burgh and the immediate built-up neighbourhood of Rothesay is ten, while those connected to the overhead lines in the Island of Bute total 114. There are thirty substations between Tighnabruaich and Otter Ferry and a further forty-seven between Colintraive and Dunoon, including the Glendaruel group. Tappings off the 33kV line north of Striven give supply to three ground-level substations and fifty-seven pole-mounted transformers. In this part of the area it has been found economical to construct certain spurs for 11kV single-phase working, supplied by 33/11kV transformers at the tee points. Supply is now available at Lochgoilhead and along the shores of Lochgoil as far as Carrick Castle.

Millport is a flourishing holiday resort and the demand for electricity in the burgh, despite the availability of gas supplies, has

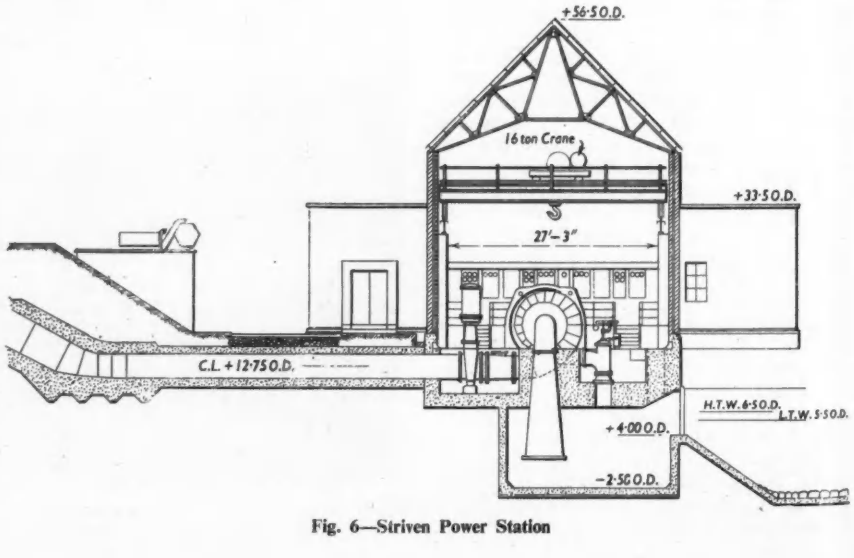


Fig. 6—Striven Power Station

been gratifying to the Board. Supply is received from Bute over the two submarine cables mentioned earlier at 11kV and fed into the low-voltage network at four outdoor substations. Facilities are provided in the high-voltage overhead lines which encircle the town to change over the supply to either circuit from Rothesay and thus provide a high degree of continuity. The low-voltage network is partly underground and partly overhead, both wooden and steel poles being used. In the rural part of Great Cumbrae supplies are provided by 8·2 miles of overhead 11kV mains, much of which is B.S. 1320 rural standard, a total of eleven substations having been installed.

Six submarine cables have been installed in connection with this scheme, two of them operating at 22kV and the remainder at 11kV. The two cables at the Colintraive crossing are respectively 692 and 729 yards long and consist of 0·04 square inch screened 22kV cables ; the northern cable between the Islands of Bute and Great Cumbrae (5835 yards long) is of similar construction but is for 11kV working. The second cable between these islands was laid some distance further south and is 5155 yards long. An 11kV submarine cable was required to complete each of the two supply routes to the Tighnabruaich area. Each is an 0·04 square inch, 11kV, three-core cable and they are respectively 958 yards and 1718 yards long.

Protection of the pole-mounted transformers throughout the scheme is provided by means of drop-out fuse switches and, where several small transformers are supplied by a spur line, a single set of fuses is provided at the tapping point to protect the group. In general, l.v. fuses are not installed where h.v. fuses are provided, and vice versa.

Because of the rocky soil in many areas, the Board has been much concerned about the earthing of its new voltage systems on account of the tendency to high earth electrode resistances. Besides the normal system employing a solidly earthed star point at the transformer and an otherwise unearthed neutral conductor, the Board has installed extensively earth continuity conductor and protective multiple-earthed neutral systems. All three arrangements have been used in the Cowal scheme to enable some comparison to be made between them.

Rothesay Power Station.—The capacity of diesel plant installed at Rothesay is 2750kW, but it has been largely relegated to standby duty since Striven power station was commissioned. Considerable alteration and extension of the electrical equipment in Rothesay power station was carried out to meet the requirements of the extended distribution scheme in Bute, including the provision of a complete new 11kV cubicle single-busbar switchboard. A small amount of the original 6·6kV switchgear has been retained to enable use to be made of two diesel generators operating at that voltage. A 750kVA inter-bus transformer is provided for the connection to the 11kV switchgear.

As indicated above, the Board has recently completed a conversion of the Rothesay 6·6kV network to 11kV, working to line up with the operating voltage of the large rural system in Bute. At the same time the changeover of the remaining d.c. consumers to a.c. supply was undertaken, the d.c. cables being reconnected for a.c. single-phase, three-wire working at 240–0–240V.

The distribution system in the Burgh of Rothesay itself consists of 11kV underground cables feeding indoor or ground-mounted ironclad substations where sectioning and protection is afforded by ring main isolator and fuse units. This network is connected at several points with the rural distribution network and the 11kV switchboard at Rothesay is, therefore, an important control centre for a large area. Protection on the feeders consists of two-pole overcurrent and single-pole earth fault equipment using D.M.I.T. relays in both cases. Earthing of the 11kV system is effected by earthing compensators connected to the h.v. windings of the 500kVA delta/double-star transformers feeding the medium voltage fuseboard at the power station.

To reduce the number of transformers and avoid the need for large single-phase units, transformers capable of supplying simultaneously three-phase and single-phase loads are installed at Rothesay power station and at five substations ; they have ratings of 500kVA and 250kVA, the windings being designed to deliver single-phase and three-phase loads simultaneously in the ratio of 4 : 1 at full load. The medium voltage control gear consists of open type distribution fuse pillars. For the combined three-phase and single-phase supplies duplicate busbar units of standard form were adapted to give the required phase-selection for the various feeders.

Dunoon Power Station.—The installed capacity of diesel plant at this station is 3300kW. It has been necessary to use this plant in periods of water shortage at Striven, but with the completion of the link with the 132kV system it would be relegated to standby duty only. At Dunoon the existing 6·6kV network in the Burgh was retained by the Board as there was no justification for raising the voltage to 11kV, there being no extensive rural development in the immediate neighbourhood of the town as there is in the case of Rothesay. There is an overhead line south of Dunoon supplying the area round Inellan, and another covering the shores of the Holy Loch. The existing 6·6kV switchboard at Dunoon was extended to receive the new supply from Striven.

The consulting engineers responsible to the North of Scotland Hydro-Electric Board for the Cowal Scheme are Messrs. Crouch and Hogg of Glasgow, for the civil engineering, and Messrs. Merz and McLellan for the electrical and mechanical aspects, and for the distribution scheme. The main contractors are listed herewith :—

Glen Tarsan dam, Col dam, main tunnel and Glen Lean and Corrahaine aqueducts, Crowley Russell and Co., Ltd. ; Garvie tunnel aqueduct, Whatlings, Ltd. ; power station and pipeline, John Woodrow and Sons (Builders), Ltd. ; turbines and alternators, Harland Engineering Company, Ltd. ; pipeline, P. and W. MacLellan, Ltd.

The construction of the 11kV and low voltage distribution lines in Bute and Cowal was undertaken by James Kilpatrick and Son of Paisley, James Scott and Co. (Electrical Engineers), Ltd., of Dunfermline, and British Insulated Callender's Construction Company, Ltd. Fraser and Borthwick, Ltd., of Glasgow, carried out the work in Millport and the rural part of Great Cumbrae and they also undertook the high voltage and low voltage network changeover in Rothesay.

The two submarine cables of the Colintraive crossing were supplied and installed by Siemens Bros. and Co., Ltd., as was the northern cable between Bute and Cumbrae ; the southern cable was supplied and installed by Pirelli-General Cables, Ltd. The submarine cable between Bute and Rudhaban was supplied and installed by Standard Telephones and Cables, Ltd., and the one between Kilmichael and Kames by Siemens Bros. and Co., Ltd.

Transformers for the scheme were supplied by Bonar Long and Co., Ltd., Bruce Peebles and Co., Ltd., English Electric Company, Ltd., British Power Transformer Company, Ltd., Brush Electrical Engineering Company, Ltd., Transformers and Welders, Ltd., Ferranti, Ltd., and Gresham Transformers, Ltd. In the rural areas transformer ratings used are mostly 5kVA, 10kVA, 15kVA, 25kVA, single-phase and three-phase, and 50kVA three-phase. The new switchgear at Rothesay and Dunoon was supplied by the British Electrical Engineering Company, Ltd., and by Johnson and Phillips, Ltd., respectively.

(*To be continued*)

Mechanical Handling in the Field

Last week the Southern Command, on behalf of the War Office, presented an exercise named "King Kong," the object of which was to demonstrate the potentialities of mechanical handling equipment in the field. The event took place at Bulford, Wiltshire, and a preliminary announcement called attention to the large labour force required to maintain the Army and to the possible saving in manpower by the use of mechanical handling equipment, while the main factor limiting its use was stated to be terrain.

A parade of mechanical handling equipment, accompanied by various ancillaries and carrying unit loads opened the exercise and was contrasted with the old arrangement of individuals and parties carrying manual loads. The vehicles shown included tracked and wheeled fork lift trucks, hydraulic jib cranes, lorry-mounted diesel-electric cranes, various designs of loading gear, a range of 3-ton trucks, tippers and a bulk cement carrier.

After the parade there was a comparative demonstration of stores being loaded and unloaded by both manual and mechanical means. At one point 25-pounder ammunition was unloaded by a manual team competing with a fork lift truck, while in the second area filled jerricans were loaded into trucks by hand, by power conveyor and by fork lift truck. The tonnages moved and the time taken were recorded and the results showed that the fork lift truck unloaded ammunition at the rate of 30 tons per man-hour against 7·5 tons per man-hour by the manual team. Loading operations gave the following results, the manual team and the power conveyor moved 4 tons and 9 tons per man-hour, respectively, while the corresponding figure for the fork lift truck was 20·5 tons.

Working displays of the equipment formed the third part of the exercise and in the first area various unit loads were shown, together with methods of preparing and of handling them. An alternative to unit loads was shown by powered conveyors, loaders and gravity runways demonstrating the handling of suitable packages, while in the third area methods appropriate for moving stores over bad ground were shown, including the use of monorail equipment, tracked fork lift trucks and the working of skid parcels.

The handling in bulk of materials such as sand, gravel and cement were demonstrated by means of tippers, auto loaders and bulk containers, while in the fifth area special equipment for handling stores was on view, such as a lorry equipped with a tail-loader, a hydraulic jib crane fitted with a hydraulic grab and another fitted with an electro-magnet and a lorry-mounted hydraulic crane. A mechanical bridging demonstration formed the final item of the exercise in which fork lift trucks were used to bring the bridging items from the unloading point to the bridge site, resulting in the minimum of manual labour. In the exercise the party using the mechanical equipment completed a section of a bridge in ten minutes against forty-five minutes required by manual methods, while the saving in man-hours amounted to 80 per cent.

The Development of Broadcasting in Great Britain

INSTITUTION OF ELECTRICAL ENGINEERS' INAUGURAL ADDRESS

No. I

The inaugural address of Mr. Harold Bishop as president of the Institution of Electrical Engineers was delivered in London on Thursday, October 8, 1953. Mr. Bishop's address was mainly concerned with the development of the broadcasting service (including television) in this country. Abstracts from the address are reproduced herewith.*

AN account of the early days of broadcasting in this country was given by Sir Noel Ashbridge in his presidential address in 1941. There has been a good deal of change in the twelve years since then, both as to the new requirements for the home programme service and developments abroad.

Frequency Allocations

The problem of frequency allocations for broadcasting grows in difficulty year by year. It is troublesome in all wavebands and particularly in the low, medium and high-frequency bands—i.e. those between 150 kc/s and 25 Mc/s. In all three of these bands national allocations can be interfered with by transmissions from other countries. These difficulties may be serious even on the very-high-frequency (v.h.f.) bands which are coming more and more into use for sound broadcasting and television. It was thought only a few years ago that the range of transmission on these frequencies would be so limited—regardless of power—that interference between stations in different countries using the same or nearly the same frequency would be unimportant.

All the bands used for radiocommunication are allocated to the various services on a world basis by international conferences held from time to time. The most recent was the International Telecommunication and Radio Conference at Atlantic City in 1947. Low and medium-frequency bands available for broadcasting were allocated to the countries in the European region at the European Regional Conference at Copenhagen in 1948 ; at the European Broadcasting Conference in Stockholm in 1952 the v.h.f. bands were similarly dealt with. Because of their worldwide range the high frequencies should be allocated on a world basis. Attempts to achieve this were made at the High-Frequency Broadcasting Conferences in Mexico City in 1948 and in Florence and Rapallo in 1950. Unfortunately, the conferences failed to reach agreement and high-frequency broadcasting continues on an unplanned basis.

Some idea of the increasing complexity of the problem on low and medium frequencies may be gathered from the following figures illustrating the growth of broadcasting in Europe.

Year	Number of stations	Total power, kW	Bandwith available for frequency allocations, kc/s
1929	200	400	1,014
1932	240	2,500	1,017·5
1939	315	8,800	1,100
1952	762	16,000	1,215

Thus between 1929 and 1952 the number of stations increased by 281 per cent while the bandwidth on which these stations must operate increased by only 20 per cent. In the Copenhagen plan, which came into operation in 1950, 243 low- and medium-frequency stations and synchronised groups were allocated frequencies, and the bands were full. After three years the number of stations and groups now working is 368 (a total of 762 individual stations), an increase of 50 per cent. As a result all stations, including, of course, B.B.C. stations, are liable to suffer serious interference.

An indication of the world growth of broadcasting is given by the figures for the number of sound receivers in all countries of the world :—

1929	26,000,000
1932	38,000,000
1939	67,000,000
1952	202,000,000

The number of broadcasting transmitters on medium and low frequencies in Europe has thus more than doubled since 1939, and the number of receivers in the world has increased threefold. It is interesting to note that the population of the world is about 2400 million, so that there is a sound broadcasting receiver for every twelve persons.

External Broadcasting

Almost every country of any size is an international broadcaster, and because of this there is an acute lack of frequencies available for the large number of transmitters operating in the high-frequency bands allocated to broadcasting at the Atlantic City Conference, 1947. The B.B.C. has 137 channels notified to the International Telecommunication Union for high-frequency broadcasting. Of these, 121 are within the limits of the Atlantic City bands and sixteen are outside these limits. Nine of the latter have been in regular use since the war, but now, in accordance with the Geneva Conference, 1951, we are being pressed to give them up so that the Atlantic City frequency table may be implemented. But sufficient replacement frequencies within the internationally agreed bands do not seem to be available. Moreover, because of the pressure on frequency space in these bands, the figure of 121 frequencies within the bands is very misleading. In fact, only about twenty are available for worldwide use without restriction or interference, and at the present time about thirty-six frequencies are used regularly but for restricted periods and to restricted areas.

The conflict in international allocations is hardly surprising, bearing in mind that the space available in some of the bands allocated by the Atlantic City Conference was as little as 25 per cent of the requirements of the participating countries.

Home Sound Broadcasting

There have been important changes in the sound broadcasting position in recent years. The increase in the number and power of stations in Europe has caused a considerable rise in the level of interference from foreign stations, and this in turn has meant that the minimum field strength for reliable reception has increased. It has been impossible to cope with this situation, because new stations of power greater than a few kilowatts are out of the question as there are no frequencies on which they could work, and there are technical limits to the extent to which it is economic to increase the power of existing stations. As a result, therefore, the area and consequently the population able to obtain first-class reception of alternative sound broadcasting programmes have in recent years tended to decrease, in face of a still-rising number of sound licences.

There is no chance of more medium or low frequencies becoming available for B.B.C. use ; indeed, we shall be fortunate if a further deterioration can be avoided. The B.B.C. distribution plan is already full of unsatisfactory compromises because of frequency limitations. Several European countries did not sign the Copenhagen Plan and are not in any way bound by its provisions ; others, dissatisfied with the number or the quality of the frequencies allotted to them, have broken away from the plan and are using frequencies to which they are not entitled. As a result, reception of the Home Service for some 5,000,000 people is unsatisfactory or impossible after dark because of heterodyne whistles, sideband "splash" from powerful Continental stations on adjacent channels, and in one or two cases audible modulation from co-channel stations. At the present time the percentage of the population able to rely on first-class reception free of interference after dark is as follows :—Home Service, 90 ; Light Programme, 98, Third Programme, 68 per cent. The problem is to assess to what extent these figures are likely to deteriorate in, say, the next ten years. Because of the increase in interference from foreign stations, and disregarding any possibility of deliberate jamming, it may well be that night-time coverage may have deteriorated in ten years' time to the following figures :—Home Service, 80 ; Light Programme, 75 ; Third Programme, 50 per cent.

Such figures would be quite unacceptable ; they could be improved, in theory at any rate, by increasing station powers, improving aerial efficiencies, or building new stations using frequencies in the same bands or in another band.

Coverage Improvement.—There are few broadcasting stations in the world having powers exceeding 100kW and fewer still exceeding 200kW. The reason is well known, but is worth repeating because of its fundamental importance. On medium frequencies the strength of the ray reflected from the ionosphere at night is comparable with the strength of the direct ray at a distance of 100 miles or so. As a result the signal at this distance is subject to fading and may be heavily over-modulated and seriously distorted. These effects may occur regardless of transmitter power, since a change in power changes the strength of both rays equally. Therefore, in planning high-quality national coverage which must depend on consistent reception of the direct ray, sufficient power is needed to ensure an acceptable signal/noise ratio at the point where the strength of the reflected ray begins to be comparable with that of the direct ray. Power increase is therefore no answer to the problem of giving an improved service. These arguments do not apply if a station is required to give a long-distance, indirect-ray service—for example, for reception in a distant country.

Much work has been done in recent years on the problem of improving the efficiency of aerials for medium frequencies. It is not so much a question of obtaining higher efficiency by reducing losses in the aerial and feeder, although these can be important, as of reducing the amount of radiation which is not parallel or nearly parallel to the ground. In this way the strength of the indirect ray

* Director of Technical Services, British Broadcasting Corporation.

can be reduced, and hence the distance from the transmitting station at which fading and distortion occur can be increased. The results of work on this subject have been incorporated in new mast radiators, and improved reception on the fringe of the service areas has been obtained. Unfortunately, however, the effect of these improvements is limited and the coverage improvement is small.

The operation of two or more stations on the same frequency has been exhaustively studied from the earliest days of broadcasting. It has only limited value in improving population coverage, because the addition of a transmitter sharing a frequency may well deprive as many people of a service as it will bring in, owing to the increase in the interference, or mush, area. To synchronise high-power transmitters and, at the same time, maintain the maximum possible service area demands that the frequencies shall be synchronised to within a few parts in 100 million. There is no difficulty in achieving this with modern quartz crystals in temperature-controlled ovens, but it may be an unacceptable restriction that the programme radiated from all the synchronised transmitters must be the same.

The B.B.C. has built a number of low-power transmitters in the past year which are synchronised with other stations, and service is now being given to about 1,000,000 people who were previously not served. But this is about all that can be done and it is no solution to the coverage problem.

V.H.F. Broadcasting.—Finally, there remains the possibility of the use of other frequency bands. Bands have been internationally agreed for broadcasting in the v.h.f. (very high-frequency) and u.h.f. (ultra high-frequency) regions, which extend from 30 Mc/s to 3000 Mc/s. The band which it has been agreed internationally shall be used for sound broadcasting extends from 87·5 Mc/s to 100 Mc/s, but in this country about half of this band has been allocated to services other than broadcasting and only 88 Mc/s to 95 Mc/s is available. Towards the end of the second world war, the B.B.C., realising the problem of maintaining and improving the sound broadcasting service in the medium and low-frequency bands, decided to explore the possibility of using v.h.f. Low-power transmitters, employing frequency modulation (f.m.) and amplitude modulation (a.m.) and working in the band 88 Mc/s to 95 Mc/s, were installed at Alexandra Palace in 1945. This was followed in 1949 by the building at Wrotham in Kent of a high-power station containing one frequency-modulated transmitter and one amplitude-modulated transmitter, each of about 20kW, working into an aerial having a power gain of eight. Extensive tests of the value of v.h.f. distribution for public service were carried out.

This full-scale experiment proved that f.m. had important advantages over a.m., and a plan for complete national coverage of three programmes using f.m. transmitters was submitted to the Government early in 1951. Restrictions on capital investment did not permit the plan to be adopted at that time, but the Government have now given permission in principle for a start to be made with the building of v.h.f. stations. The relative merits of f.m. and a.m. are being examined by the Television Advisory Committee; the B.B.C. hopes that its 1951 recommendation in favour of f.m. will be adopted.

The building of these new v.h.f. stations will take several years. They will provide a powerful reinforcement to the service given by the existing medium- and low-frequency stations, and the ultimate effect will be that a much more reliable sound service of three programmes will be provided. It will, of course, be necessary for listeners to buy adaptors or new receivers for the new service, but it will be a long time before this is done throughout the country. For many years, therefore, the present distribution system will remain in service. The new v.h.f. stations will first be built in areas where reception is now poor, and in these areas there will be an incentive to purchase new receivers to take advantage of the improved service.

To fulfil this plan the B.B.C. contemplates building fifty-one transmitters installed at nineteen locations, nineteen for the Home Service, sixteen for the Light Programme and sixteen for the Third Programme. All of them will operate on frequencies between 88 Mc/s and 95 Mc/s. Later, additional transmitters will be built to complete national coverage.

It is of interest to mention that, partly because the number of medium-frequency channels allocated to Germany under the Copenhagen plan was considered to be insufficient to meet their requirements, the development of sound broadcasting distribution by very high-frequency f.m. stations has been very rapid indeed in that country. There are already 103 transmitters, mostly of low power, in operation in Western Germany, and over 4,000,000 v.h.f. receivers or adaptors are in use.

(*To be continued*)

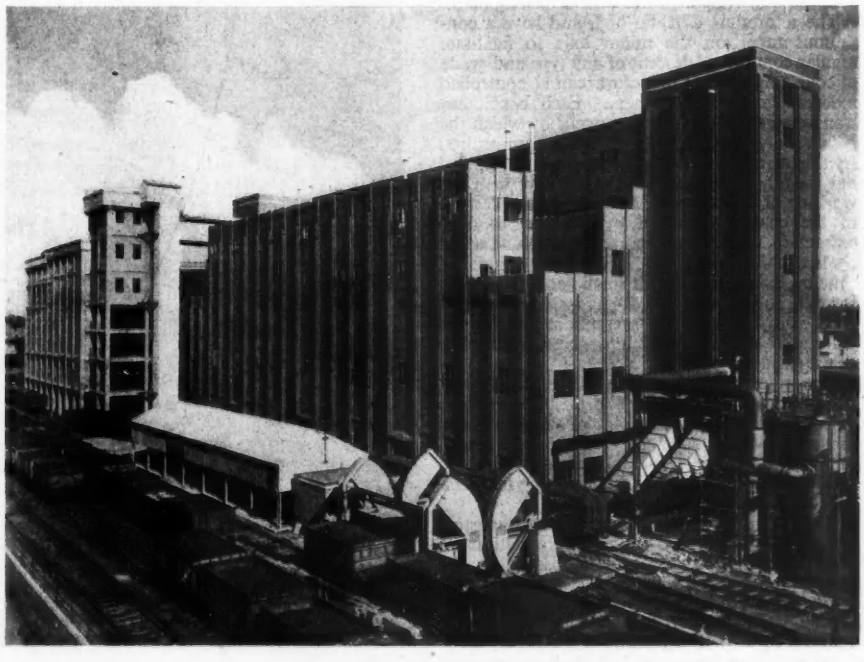
Swan Village Gasworks

A new gasworks which has been laid down adjoining the original works at Swan Village, near Birmingham, has a coal-gas plant with a capacity of 8,500,000 *cubic feet of gas a day. In conjunction with the new plant the water-gas plant of the original works has been extended by the installation of a new water-gas machine with a daily capacity of* 3,000,000 *cubic feet.*

WHEN it became evident in 1946 that substantial extensions would be necessary to the gas-making plant at the Swan Village gasworks in order to meet the steadily increasing demands, an adjoining site of 11 acres was acquired for the construction of a new works. This works has been completed and was officially opened last Friday by Colonel Sir Harold Smith, the chairman of the Gas Council. It has made available to the West Midlands Gas Board an additional 11,500,000 cubic feet of gas a day. Under the scheme a coal-gas plant of 8,500,000 cubic feet per day has been installed on the new site, and a new 3,000,000 cubic feet per day water-gas machine has been installed in an extension of the water-gas house at the old works. The water-gas is piped in the crude state to the new works where it is metered and then purified with the coal-gas.

With this combination of coal-gas and water-gas plants the new retort house will normally operate at high throughputs, making gas of high calorific value, and the water-gas of low calorific value, with a minimum oil enrichment, to produce a mixed town's gas of 450 B.Th.U. per cubic foot. This is considered to be the cheapest method of working under present circumstances, but the operating conditions can be varied within wide limits by reducing coal throughput in the retorts, using more oil on the water-gas plant and producing less coke for sale whilst still maintaining the same total production of gas. It is pointed out that the flexibility of this combination of plant is such that without alteration to total gas made, annual coal requirements can be varied between 180,000 and 138,000 tons, with corresponding variations in coke available for sale, between 61,000 and 34,000 tons, based on a load factor of 83 per cent.

Coal brought into the works in railway wagons is either stacked for subsequent reclaiming as required or discharged directly into the coal-handling system feeding the vertical retort house. The coal storage ground is in the form of an open concrete box 336ft long by 98ft wide by 13ft 6in deep in which some 18,000 tons of coal can be stored. Spanning the ground, and running on tracks laid on the reinforced concrete store



Rear of Retort House

Hot Gas Detarrers

walls, is a 10½-ton crane with a coal-handling grab.

The coal for storage is unloaded from the rail wagons by one of two electric ram end tippers into a grab pit at the centre of one side of the store. From this pit the coal is transferred to any part of the store by the crane. The crane, which is electrically operated, permits stacking to a height of 32ft and its grab has a capacity of 5 tons of coal. Coal reclaimed from the store is delivered by the grab directly into railway wagons via a retractable hopper chute built as a cantilever extension of the crab track.

In the carbonising plant the continuous vertical retorts, supplied by the Woodall-Duckham Construction Company, Ltd., comprise four benches each containing 16in by 82in retorts designed for a throughput of 530 tons of coal per day, giving a daily gas output of 8,500,000 cubic feet at a calorific value of 475 B.Th.U. allowing for normal scurfing. This installation includes coal, coke and ash-handling plants, a producer gas plant and four waste-heat boilers. In the photograph of the rear of the retort house, which we reproduce on page 487, there can be seen the wagon tipplers and coke-screening plant.

The retorts are 27ft 4in high and have a continuous taper on the minor axis to facilitate regular continuous descent of any type and grade of coal. Any one of the retorts can be controlled independently of the others. Each bench has transverse air-cooled division walls by which the bench is divided into four sections of four retorts. By this arrangement cold repairs can be carried out on any section without interfering with the working of the others. The speed of the descent of the coal is regulated by the rate of coke extraction, and the coke extractor gear is actuated by hydraulically operated rams on a controlled time cycle. Residual heat in the coke is utilised for the production of water-gas inside the retorts by the admission of low-pressure steam through calibrated nozzles fitted into the curved plate of the extractor box.

The retorts are heated by the "Lambent" heating system using hot dedusted producer gas. There is only one point of admission and control of producer gas on each side of a retort, and secondary air for combustion is admitted at three or more levels, thus permitting temperature zoning as required.

The retort seating castings and supporting steelwork are cooled by the circulation of secondary air, prior to its admission to the settings. This arrangement is designed not only as a safeguard against overheating, but also to enable the producer fuel consumption to be reduced by 7 to 10 per cent.

At the retort house tipplers discharge the coal into a brick-lined steel receiving hopper of 80 tons capacity having two bottom outlets through which the coal is fed, via chutes and vibrating feeders, to either of two inclined tray conveyors. Each conveyor delivers to one of two four-roll breakers which reduce the coal to a maximum of about 2in cube. The coal is then fed by rotary fillers on to one of two gravity bucket elevators in the end bay of the retort house. From these elevators the coal is fed by band conveyors into storage hoppers above the retort benches. From the storage hoppers, which have a capacity of forty-eight hours' coal requirements, the coal is fed through rotary valves into auxiliary supply hoppers attached to the top mouthpieces of the retorts.

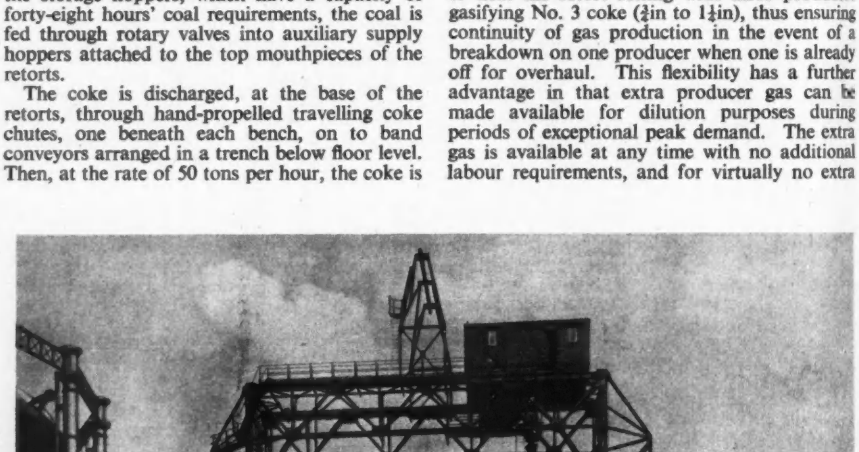
The coke is discharged, at the base of the retorts, through hand-propelled travelling coke chutes, one beneath each bench, on to band conveyors arranged in a trench below floor level. Then, at the rate of 50 tons per hour, the coke is delivered to gravity bucket elevators, which discharge to the screening plant.

Graded coke for the producers and retort house purposes is weighed in rail wagons, discharged by wagon tippler and then conveyed to the appropriate overhead storage hoppers. Each mechanical producer has its own fuel storage hopper of forty-eight hours' capacity. The coke for filling retorts at starting up, or after scurfing, is discharged from separate storage hoppers into hand-propelled filling skips running on double overhead tracks extending for the full length of the retort benches.

Gas leaves the retorts through off-take pipes and is sprayed with hot liquor before passing through liquor-sealed dish valves into collecting mains serving eight retorts. Each collecting main is arranged with a fall towards the centre where a tar and liquor overflow and cleaning box is fitted so that the tar and liquor deposited can run into tar and liquor separating tanks. The decanted liquor overflows to a clean liquor tank and together with "make-up" liquor is pumped back to the sprays in the collecting mains and gas offtakes. Gas leaves each collecting main via a vertical main in which is inserted a butterfly valve operated by "Askania" regulator to give precise control of gas pressure at retort offtakes. All vertical mains enter a common foul gas main which carries the crude gas away from the retort house. For heating the retorts there are four 8ft diameter mechanical producers, supplied by Humphreys and Glasgow, Ltd. These producers have annular boilers which generate sufficient steam at 20 lb per square inch to saturate the air blast.

The producer grate, together with the ash pan, is rotated at a rate which can be varied to suit different kinds and grades of fuel and the quenched ash and clinker are extracted through the water seal and discharged into ash skips. Air blast is provided from four electrically driven blowers, any two of which are large enough to supply the necessary air to four producers.

Each producer is rated to gasify 18 tons of No. 4 coke (⅜in to ¾in) per day, but it is possible to heat the retort setting with three producers gasifying No. 3 coke (¾in to 1¼in), thus ensuring continuity of gas production in the event of a breakdown on one producer when one is already off for overhaul. This flexibility has a further advantage in that extra producer gas can be made available for dilution purposes during periods of exceptional peak demand. The extra gas is available at any time with no additional labour requirements, and for virtually no extra



Tower Purifiers

capital, but requires further oil enrichment on the water-gas plant to compensate for the low calorific value of the added producer gas. Producer gas so used for dilution is passed through two simple washers and coolers where it is sprayed with water or liquor before joining the foul gas main.

Gas leaving the producers passes through cyclone dust separators and then goes forward to the retort settings at a temperature of about 500 deg. Cent. The layout of the producers, in relation to the producer gas main and retort benches, is such that the portion of producer gas main to any one bench can be isolated for repairs without affecting the working of the other benches or the availability of a spare producer.

Each bench of sixteen retorts has its own waste heat boiler, superheater and economiser. The total steam output from the four benches is 22,000 lb per hour at 350 lb per square inch and superheated to 650 deg. Fah. This steam passes to back-pressure turbo-alternator sets exhausting at 20 lb per square inch, this exhaust steam being used for process work.

To assist in the ventilation of the retort house two cold air circulation plants have been installed and these plants deliver air along the full length of each bench. To assist in maintaining clean working conditions two vacuum cleaning plants have been installed in the house by the Sturtevant Engineering Company, Ltd.

As already mentioned, a water-gas plant has been installed in an extension of the existing plant in the old adjoining gasworks. The new equipment was supplied by Humphreys and Glasgow, Ltd., and it consists of an automatically operated water-gas machine with a daily capacity of 3,000,000 cubic feet. It is designed to produce gas of any calorific value from 300 to 600 B.Th.U. per cubic foot, and comprises a self-cleaning generator, carburettor, superheater, washer and primary condenser. Waste heat steam is generated in a horizontal boiler at 135 lb per square inch and superheated by 200 deg. Fah., and low-pressure process steam at 35 lb per square inch is produced in the generator annular boiler.

The turbo-alternator sets, which are supplied with steam from the waste heat boilers, have a total output of about 700kW. No fuel-fed boilers have been installed and the works is fully self-supporting for its steam supplies. To supplement the power supplies at times when the demands for the gas boosting plant are particularly high, two independent grid supplies at 6600V are provided. The whole of the works electrical system is controlled from an elevated control room in the power-house.

Two hot gas detarrers have been installed at the immediate outlet of the retort house in order to remove the heavy tar and the majority of the polyhydric phenols before the liquor is condensed. Each detarrer is designed to deal with 6,000,000 cubic feet per day and the two units will normally operate in parallel for the full load of 8,500,000 cubic feet per day, although one can deal with this full load at 90 per cent efficiency. To use some of the sensible heat and latent heat in the gas leaving the hot detarrers, a vertical water-tube, double-pass water preheater has been installed between the detarrers and the primary condensers. This unit preheats towns' water to 120 deg. Fah. before it passes to the softening plant.

Three vertical water-tube, multi-pass gas condensers, each of 4,500,000 cubic feet per day capacity, are arranged in parallel so that one unit can act as a stand-by. These condensers are designed to work on hard well water, and cool the gas to 65 deg. Fah.

Two three-stage Bryan Donkin turbo-exhausters are installed in the power-house, with two turbo-alternators and four " Connersville " meters. The exhausters are designed for a top speed of 2860 r.p.m. and are driven by 2950 r.p.m. motors of 110 h.p. through scoop-controlled fluid couplings to give a speed variation down to 50 per cent. Each exhauster is capable of dealing with 415,000 cubic feet of gas per hour at a pressure difference of 53in water gauge.

A single secondary detarrer has been provided at the outlet of the exhauster to practically eliminate the small amount of tar fog arising from condensing and remaining after the turbo-exhausters. Three four-bay static washers are arranged in series with gas connections arranged for any washer to be by-passed if necessary : a liquor strength of 14 oz can be attained on full load with all washers in operation. Cold effluent liquor from the liquor concentration plant is fed to the last washer in lieu of water or weak liquor to avoid increasing the volume of liquor for disposal.

A single four-bay static washer can deal with 11,000,000 cubic feet of mixed coal-gas and water-gas per day, and serves to reduce the dew point of any oil or gum-forming vapours which might otherwise condense in the oxide purifiers and adversely affect their operation. Gas oil is fed at the rate of 40 gallons per 1,000,000 cubic feet and the oil overflow is returned to the carburetted water-gas plant at the old works. The two hot gas detarrers, which are shown in one of the illustrations on this page, were supplied by Whessoe, Ltd., as were also the condensers and washers.

The dry purification plant, which is shown in another of our illustrations, comprises six tower purifiers made by W. C. Holmes and Co., Ltd. This plant is designed for the removal of H_2S from 8,500,000 cubic feet of coal gas and 2,500,000 cubic feet of water-gas per day. Its six towers, each 22ft 3in diameter by 52ft 9in high, are connected in series and each has twelve removable containers. Spare containers are kept ready filled with fresh oxide in a stocking frame, and, using a crane spanning the site, one tower can be emptied and refilled in eight hours. Oxide containers are transferred individually to an unloading gantry and the oxide is discharged to a receiving hopper beneath.

All gas made in the new plant is metered through four " Connersville " meters, three of which deal with the purified mixed gas and one of which measures the unpurified water gas prior to its admission to the coal-gas stream. Tar from the retort house separators and hot gas detarrers flows by gravity to a storage well in the old works. The ammoniacal liquor is also piped to the existing storage well in the old works, where all ammoniacal gas liquor is treated.

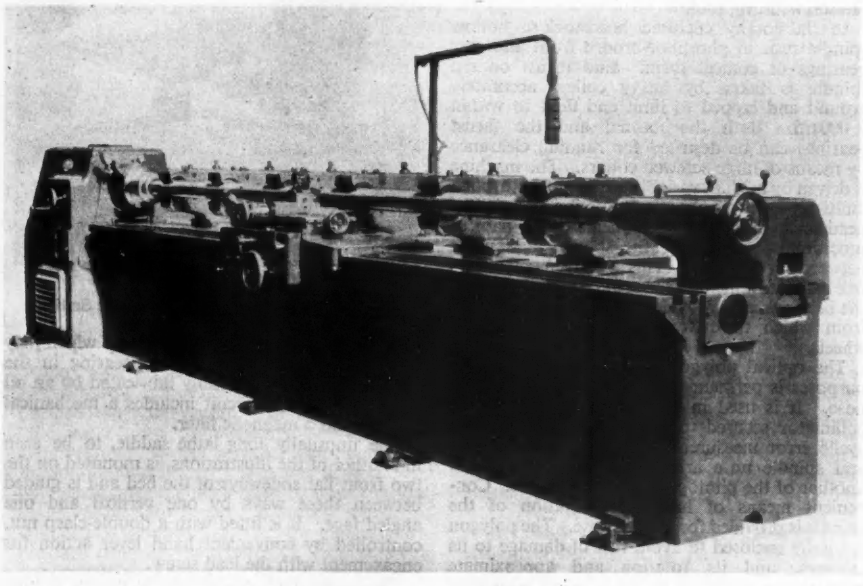
The whole of the gas from both the old and the new works, which totals some 21,000,000 cubic feet a day, is distributed to three medium-pressure mains by three Bryan Donkin boosters. Two of these boosters have a capacity of 1,200,000 cubic feet per hour at 90in W.G., and one of 900,000 cubic feet per hour at 42in W.G. outlet pressure.

A Precision Screw Thread Corrector Lathe

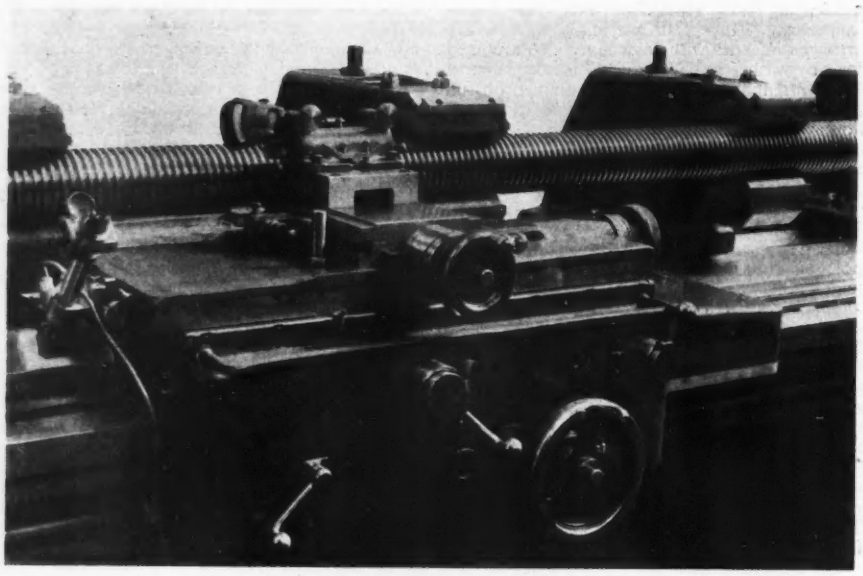
An essential element for the accurate operation of gear hobbing machines is the hob-slide feed screw, and a new high-precision corrector lathe for the finishing of such screws has been developed and built by Craven Brothers (Manchester). On this machine a screw thread can be accurately measured in position after cutting and the corrector mechanism can be directly adjusted to precision gauge readings as required.

AN interesting new high-precision screw thread corrector lathe has been developed and built by Craven Brothers (Manchester), Ltd., Reddish, near Stockport, primarily for use in connection with the manufacture of hob slide feed screws for gear hobbing machines. Precision master lead screws of this kind are usually cut by normal production methods and finished on a corrector lathe. With such a finishing lathe the usual procedure is to take a fine trial cut along the thread and then transfer the screw to a separate " bench " for measurement. The screw is then replaced in the lathe, the corrector mechanism of which is adjusted to advance or retard the rate of tool travel in relation to work rotation, as indicated by the bench measurements to be necessary for the improvement of the screw. The thread is then re-cut and measured again, a process which it may be necessary to repeat several times before the required accuracy is obtained.

The new " Craven " machine has been designed to eliminate the need for repeated removal of the screw for measurement, since it constitutes both a corrector lathe and a measuring bench. On the machine a screw thread can be accurately measured in position immediately after cutting, and the corrector mechanism directly adjusted to gauge readings as required. Further, it is possible for the lathe motion to be accurately checked and corrected before the screw is placed in position. This is effected by the use of an auto-collimator and optical polygon for spindle rotational setting against a precision " Watts " line standard for



Screw Thread Corrector Lathe



Corrector Lathe Saddle

saddle traverse and it ensures that the motion of the lathe is itself correct before thread cutting proceeds.

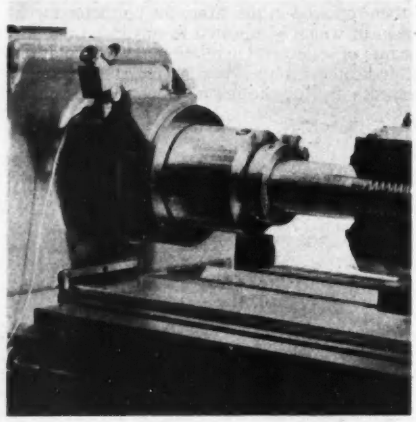
On this machine screws up to 10ft long and from 2in to 5in diameter can be corrected, but an actual overall length of approximately 14ft 6in can be accommodated between centres. The spindle speeds available range from 5 r.p.m. to 15 r.p.m., and the maximum and minimum pitches dealt with are 1in and 0·25in (24mm and 5mm) respectively.

The lathe is designed solely for screw correction purposes, with accuracy the only consideration, and its construction, as can be seen from the illustration on the previous page, is very simple. The bed has a full depth for the whole of its length and its accuracy of level is maintained by the use of closely spaced, screw-operated levelling wedges arranged along its length. Two flat shears at the front of the bed carry the saddle and form a trough to house the lead screw. The rear portion comprises one vee and one flat slideways, which carry a set of six work supports and the loose headstock. In this manner the work is supported for the whole of its length from the bed and is in no way dependent in this respect upon the saddle. The supports have large capped bearings fitted with interchangeable bushes to suit the particular diameter of screw being corrected, and these bushes are partially cut away at the front to allow clear passage of the screwcutting tool.

In the totally enclosed headstock a hollow spindle runs in phosphor-bronze front and rear bearings of conical form. End thrust on the spindle is taken by heavy collars accurately ground and lapped to limit end float to within 0·0001in. Both the journal and the thrust bearings can be adjusted for running clearance by means of large screwed collars. The machine is driven by a 2 h.p. variable-speed motor through multi-vee belts to a worm reduction gear in the headstock, and thence by means of a pair of precision spur gears to the spindle at a point between its bearings. This arrangement allows free axial movement of the spindle when adjusting the bearings, and provides a convenient shaft end from which to drive the screwcutting change wheels.

The optical polygon used for spindle setting purposes is permanently attached to the spindle nose. It is used in conjunction with an auto-collimator secured to the headstock casing for cyclic error measurement. The auto-collimator and spindle nose arrangement can be seen in another of the photographs we reproduce. Convenient means of handwheel rotation of the spindle is provided for this purpose. The polygon is totally enclosed to avoid risk of damage to its surfaces, and its rotation and approximate position are indicated by an adjacent graduated disc viewed through a small observation window.

The lead screw of the lathe, which rotates in bearings mounted in the bed, has means of adjustment for the elimination of end float, and is housed in a trough formed between the two front bed ways. It is supported for the whole of its length and is partially immersed in oil. Telescopic guards are fitted, so that the screw is totally enclosed at all times. Screwcutting change wheels, mounted on taper shaft ends at fixed centre distances, connect the lead screw to the headstock driving shaft. All the usual inch pitches and most of the more commonly used metric pitches can be obtained without the use of a swing frame, and change-over from inch to metric pitches is effected by a simple hand lever movement. The final driving gears run in oil and are mounted on the screw immediately against the inner face of the specially designed end bearings. With this arrangement deflection of the screw driving shank due to tooth load is reduced to a minimum. The means provided to eliminate end float in the screw serve to remove



Checking Unit for Headstock Spindle Setting

any persistent error of a cyclic nature which may be revealed. All bearings and gearing in the headstock are automatically lubricated by an oil pump and the oil circuit includes a mechanical strainer and a magnetic filter.

The unusually long lathe saddle, to be seen in another of the illustrations, is mounted on the two front flat slideways of the bed and is guided between these ways by one vertical and one angled face. It is fitted with a double-clasp nut, controlled by convenient hand lever action for engagement with the lead screw.

The upper face of the saddle carries a long intermediate or "corrector" slide, which is supported on special ball tracks for sensitive movement in a direction parallel to the axis of the lathe, and it is held back by spring pressure against the knife-edged short arm of a crank lever pivoted on ball bearings in the saddle. The longer arm of this same lever contacts a flexible corrector bar accommodated in a recess along the front bed shear and supported on a series of brackets with means of fine vertical screw adjustment. By this means variations in the setting of the corrector bar are accurately transferred with a 50 to 1 reduction into longitudinal motion of the corrector slide.

A second longitudinal slide, mounted on top of the corrector slide, carries the actual tool slide and its tool post, together with a special measuring head and separate microscope. The microscope is secured to the end of the slide and is arranged to focus upon the previously mentioned "Watts" line standard housed in a recess along one of the bed shears. Hand-operated fine-pitch screw adjustment, with provision for the elimination of backlash, enables this upper longitudinal slide to be adjusted in the direction of the machine axis independently of the corrector slide for the application of side cut to the tool. This second longitudinal slide adjustment is suitable for fine setting either of the tool or the miscroscope and is controlled by a vernier reading to 0·00005in.

When the saddle clasp nut is out of mesh with the lead screw the saddle can be moved along the bed by means of a handwheel and rack and pinion gearing. An adjustable trip mechanism is arranged to operate a limit switch in the event of saddle traverse overrun.

The tool slide has a short transverse screw adjustment for depth of cut setting, a micrometer dial reading to 0·0005in being provided for this purpose. A separate cam mechanism is also fitted for quick withdrawal of the tool or measuring head stylus from the screw thread. Adjustable stops are provided on the side of the tool slide for setting depth of cut, and there are also facilities for the use of an ordinary clock gauge for this purpose.

The measuring equipment is securely fixed, when required, on top of the tool post, and it includes a special measuring head carrying a single stylus point and a spigot dial gauge reading to 0·00005in. The stylus is controlled by a sensitive knob, which allows it to contact the thread flank under constant spring pressure and to register directly upon the dial gauge. Thus, by a comparison of the dial gauge readings and micrometer observation of the line standard the thread pitch condition can be precisely determined at any given point on the screw. Any necessary compensation can then readily be made by adjustment of the corrector bar, and the extent of this adjustment is indicated directly on the dial gauge.

The work support members are arranged to carry a narrow full-length board and graph paper for convenience in plotting the screw calibrations. The tailstock of the machine is equipped with interchangeable live and dead cone centres for use as required. For special precision work the centre is completely replaced by a flat-fronted adaptor arranged merely to bear against a single thrust ball placed in the central hole of the work-piece, thus providing efficient end location only, and eliminating the risk of rotational errors which may otherwise emanate from this point.

The new lathe is being installed with other special high-precision machines in a workshop where the temperature is controlled to within 1 deg. Fah.

Technical Report

Some Considerations on the California Bearing Ratio Method for the Design of Flexible Pavements. By R. E. Kerkhoven and G. M. Dormon. London: Shell Petroleum Company, Ltd., Victory House, 99–101, Regent Street, W.1.—This report has been prepared by members of the staffs of the Shell Research Centre at Amsterdam and the firm's London office, for the use of engineers responsible for the design of flexible "pavements." The California bearing ratio method is reviewed and a mathematical expression for some of the design curves is deduced. A tentative formula is developed in the second part of the report, which includes an additional factor, viz., the number of repetitions of loading in the designed life of the construction; this formula is stated to be a more general form of the formula deduced for the design curves.

Beam Engines at Stoke Newington

JUST under 100 years ago there were installed at the Stoke Newington pumping station, London, of the old New River Company a coupled pair of simple engines designed and built by Boulton and Watt and two pairs of compound engines designed by David Thomson and built by J. Simpson and Co.

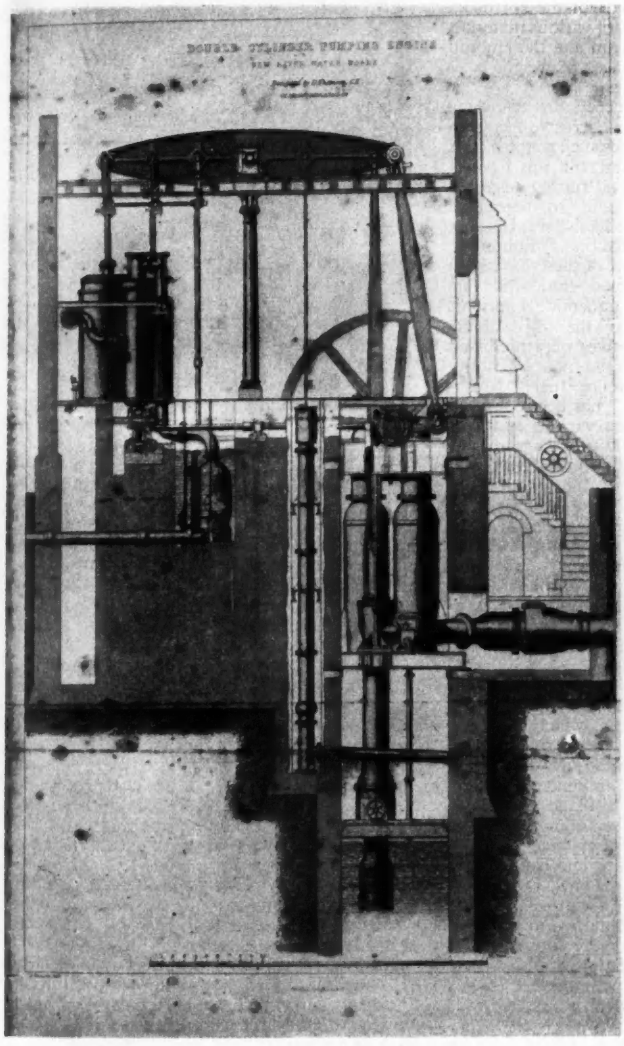
The work was carried out in 1856 under the direction of the company's engineer, William Chadwell Mylne, who also designed the pump house. The job of the engines was to lift water from the New River filter beds to the Dartmouth Park Hill reservoir, and later, to the Crouch Hill reservoir, a height of 133ft. Mylne's ideas on pump-house architecture were unorthodox. It is said that he based his general conception of the Stoke Newington building on the Keep of Edinburgh Castle, but that, finding the true proportions at odds with the building's function, he borrowed those of Stirling Castle. Closer inspection, however, reveals that the building's ornamentation is far from superfluous. The three buttresses that adorn the west wall are, in fact, hollow and house parts of the flywheels within; the stumpy tower in the north corner contains the spiral staircase that gives access to the beam loft, and the taller tower diagonally opposite conceals the standpipe. The six engines this house contained became in due course the property of the Metropolitan Water Board of London. Now their day is done. They are in course of being dismantled by George Cohen, Sons and Co., Ltd. The Boulton and Watt engines, named "Lion" and "Lioness," have beams measuring 28ft between bearing centres and weighing 22 tons, each being cast in two cheeks. Their common flywheel was Lancashire built in ten segments and each spoke is individually keyed to rim and hub; its diameter is 25ft and its weight 35 tons. The beams of the Simpson engines, although also 28ft long, weigh only 11 tons, while the two 18ft diameter flywheels weigh 25 tons each.

It would appear that the choice of two sets of compounds and one of simples was made deliberately with the idea of comparing the relative merits of the rival systems. But no proper tests seem to have been carried out. John Bourne, in his *Treatise on the Steam-Engine*, claimed that the venture had established that "the use of two cylinders involves a needless complication, as has always been maintained by Boulton and Watt." That was in 1872. But nine years later opinions seem to have changed, for in 1881 "Lion" and "Lioness" were compounded by Simpsons! The new high and low-pressure cylinders had bores of 48in and 77in respectively and a stroke of 8ft. They stepped up the engines' power to 500 h.p. and enabled the four pumps to which they were connected to deliver approximately 14,000,000 gallons per day at fourteen strokes per minute. The valve gear was actuated by a bevel pinion mounted on the fly-wheel hub and fitted with teeth of hornbeam, engaging with a cast iron pinion. It says something for these teeth that after ninety-eight years' working not one has had to be replaced through wear.

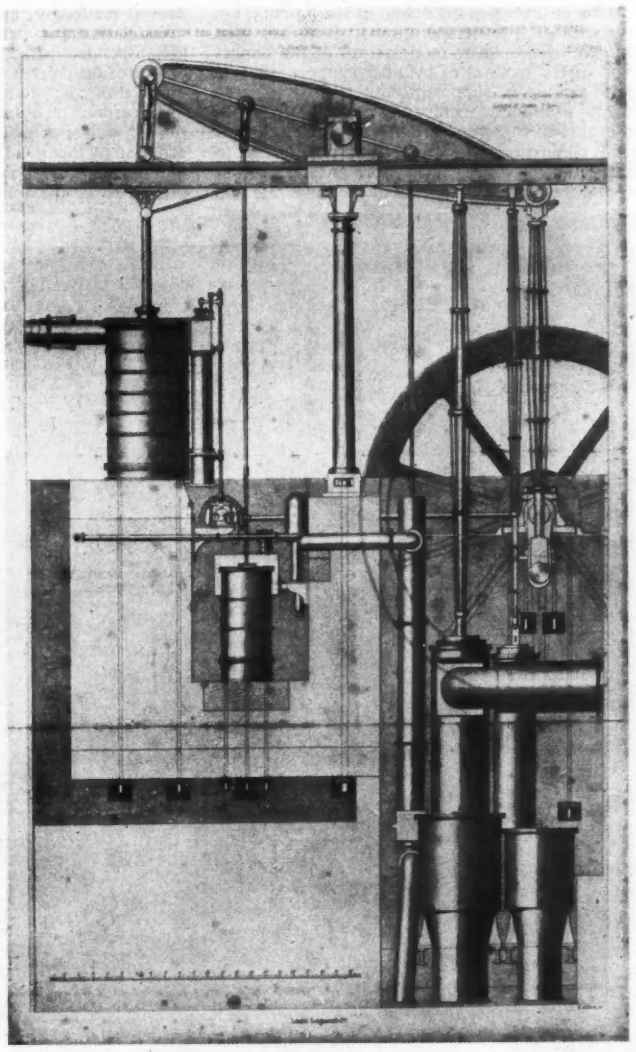
The smaller engines also underwent modification, their original piston valves being replaced in 1880 by drop valves. Each pair developed 360 h.p. and pumped 6,000,000 gallons per day at fifteen to sixteen strokes per minute. Their thermal efficiency—about 8 per cent—while not spectacular, was none the less quite good for the day.

Once these modifications were completed, the engines settled down to over seventy years of almost uninterrupted work. An occasional break for one or two hours was all they could be given and at times they ran for months without a pause. Yet only once was there a major breakdown. It occurred in 1908, when a pump rod on "Lion" snapped. The job of repairing it was given to the Swedish Arc Welding Company, and despite the fact that arc welding was then in its infancy, the joint stood up to another forty-odd years of service. The Board has asked that the rod be returned so that this weld can be properly examined.

"Lion" and "Lioness" stopped work last year. The Simpson engines were shut off for the last time in July this year. The drawings reproduced from John Bourne's *A Treatise on the Steam Engine*, show the engines as originally installed.



Simpson Compound Engine



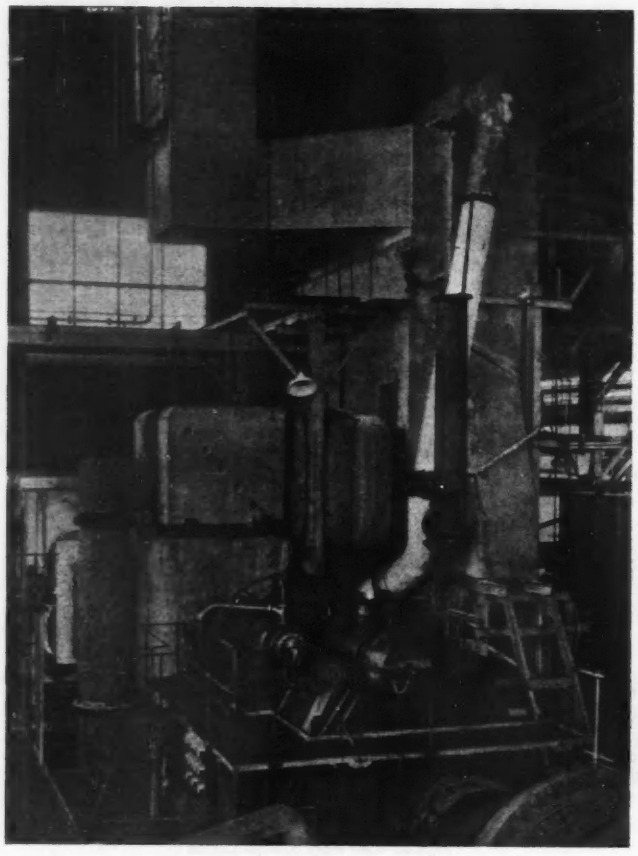
Boulton and Watt Simple Engine

Pametrada Research Station

The Parsons and Marine Engineering Turbine Research and Development Association recently held an open day, and visitors were able to tour the research station and see some of the results of completed tests and experimental work at present in hand. In the following account we record some of the main developments.

ON Monday, October 5th, we were able to pay a brief visit to the Parsons and Marine Engineering Turbine Research and Development Association's research station at Wallsend-on-Tyne to see something of the current experimental work and of the projected research programme. One illustration shows the 3500 s.h.p. marine gas turbine, which was designed in 1946 and ran for the first time in 1950, and has been developed to the stage where it can be considered as a practical basis on which a set of ship machinery could be designed from the data accumulated from tests during recent years. Although now out of date the turbine will continue to serve as a research tool and diagrams showed proposed modifications designed to solve specific problems.

One of these was distortion of the h.p. and l.p. turbines at high temperatures, which has been largely overcome by modification of the flanges and of the method of cylinder support, while a new method of supporting the casing so that it forms a strength member is expected to prove the answer to some of the remaining problems and eliminate casing distortion. In order to assist the rotor to heat up more quickly, so that it and the stator can expand at the same rate and so avoid the change of a rub occurring, modifications are proposed which incorporate a form of blade fixing which reduces the thermal inertia of the rotor by "gashing" between the closely spaced rows of blades.



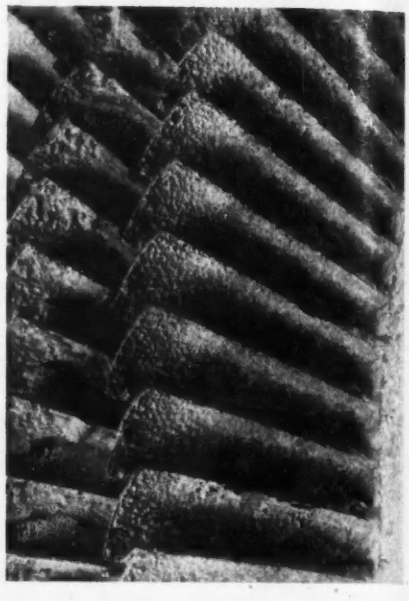
Marine Gas Turbine

Last year a full power test lasting 100 hours was completed and the plant was subsequently inspected by Lloyd's, the fuel used being a distillate, and a consumption of 0·505 lb per brake horsepower per hour was recorded, while a specific consumption of 0·491 lb per brake horsepower per hour was achieved. However, to compete with diesel machinery the gas turbine must be able to run on residual fuels, but although there is no difficulty in burning such oils the combustion products present two major problems, turbine fouling and the corrosion due to the presence of vanadium pentoxide. The illustration reproduced herewith shows the deposits on the h.p. turbine blades. Investigations to solve the problems have involved a search for a blade material resistant to vanadium bearing ashes, an endeavour to remove ash from the oil, the use of additives to render the ash non-sticky, and an attempt to remove the ash from the hot gases before they reach the turbine. Attempts to remove the vanadium from residual fuel have proved ineffective, and as part of the corrosion investigation specimen blades of various materials are suspended in the gas stream and the amount of corrosion determined by loss of weight after removal of corrosion products.

A certain measure of success in rendering the ash non-sticking and non-corrosive has been achieved by the use of additives such as the oxides of zinc, calcium or magnesium, but this has not proved to be the solution, and further tests are in hand to determine the effectiveness of other corrosion inhibitors. Some of these have been injected into the fuel as aqueous solutions, while the oil soluble additives were premixed with the fuel. Admiralty reference fuel "Mothball" has been used and of the various additives employed diagrams of results showed that ethyl silicate appeared to hold out most promise, and the indications are that the problems will be solved at an early date. For the turbine fouling investigation the rig consists of an experimental combustion chamber burning "Mothball" fuel and the exhaust is passed through the gas turbine which drives a compressor to provide the necessary air supply. The amount of fouling of the blades is obtained by taking periodic measurements of the swallowing capacity of the turbine, while the gas stream is sampled to obtain a measure of its solid content.

Work being carried on with respect to gas turbine fuel systems was on view. A new combustion system is being developed for the projected high-temperature, liquid-cooled turbine, consisting of a number of flame tubes exhausting into a common mixing zone so that a flame tube may be shut down at part load. An arrangement for replacing sprayers has been developed and the example shown consisted of two tubular sprayers slightly offset from the axis of the combustion chamber and at a small angle to it, and arranged so that either could be removed without shutting down the engine. Another assembly represented a fuel system including a lubricating oil operated control block and a fuel sprayer fitted with a remote-operated shut-off valve, while there was an experimental system having a spill-controlled pattern sprayer with an internal shut-off valve which is operated by reversing the direction of oil flow.

During the visit manœuvring was demonstrated to show the transmission of power through the ahead and astern hydraulic couplings to the double reduction gearing, seen in our illustration, and a drawing gave general details of a reduction and reversing gear which is being designed on the epicyclic principle by Pametrada. The unit consists of three epicyclic gears, two forming a reversing train and the third giving the final reduction to propeller shaft speed, the reduction ratio being 36 to 1 in both directions. Two brakes perform the reversing operation



Blade Deposits in H.P. Turbine

and the weight of the unit, which is designed to transmit an ahead power of 7500 s.h.p. at 3600/100 r.p.m., and an astern power of 5350 s.h.p. at 3200/89 r.p.m., is expected to approximate 25 tons. Such a gear, besides serving gas turbines, will avoid the necessity of fitting an astern turbine in steam turbine machinery and so solve thermal expansion problems. A development of the type "A" astern coupling installed in the gear-case of the gas turbine was shown under test in the form of a 20 h.p. model reversing hydraulic coupling.

Many problems associated with the running of compressors, such as surging and blade vibration, are under investigation, and to study these an experimental compressor is to be used. Since accuracy in manufacture is vital to the performance of an axial-flow compressor special attention is being paid to blade forms and settings, and there was on view a goniometer which accurately measures the setting of stator blades by optical means, for the investigation of which special instruments have been designed by Pametrada.

The 3500 s.h.p. marine gas turbine was designed by Pametrada for a working temperature of 670 deg. Cent., but the trend of development is towards higher gas temperatures upwards of 1000 deg. Cent. to give higher efficiency and a smaller engine and settings.

The limiting factor is mainly the temperature which the blading can withstand and the possibilities of liquid cooling are under investigation. For this purpose a special apparatus has been designed to test the possibilities of the liquid cooling of gas turbine rotor blades which are highly stressed due to high rotational speeds. Two circular tubes, carried at the end of rotating arms, represent the blades and are filled with a coolant, while the blade roots and disc rim are cooled by circulating water. Forced internal circulation of the blade coolant is set up by the high gravitational field generated by the centrifugal forces, about 30,000 g. being set up at 1100 r.p.m. in the test rig. Heat is supplied

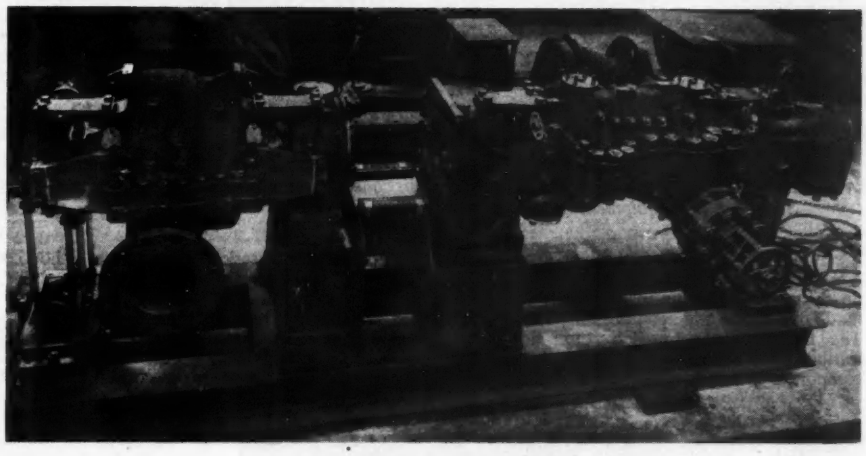
electrically to the outer sections of the tubes and the rapid circulation of the coolant is expected to give a high rate of cooling.

The same method cannot be applied to fixed blades, so that, in view of the high temperatures envisaged, 2200 deg. Fah., consideration is being given to using refractory materials for their manufacture. Although able to withstand such high temperatures the refractories tend to be brittle and shatter under thermal shock, and experimental blades made from refractories with high thermal shock resistance developed by the Morgan Crucible Company, Ltd., are being tested in a high velocity gas stream at 2200 deg. Fah. under engine conditions. Concurrent with the experimental work Pametrada is engaged in the manufacture of an experimental single-stage turbine having refractory fixed blades and liquid-cooled moving blades.

Steam Turbine Research

In the machinery trials building full scale trials were being carried out on Admiralty prototype machinery, the power being absorbed by the 60,000 s.h.p. Heenan and Froude water dynamometer. An experimental high-temperature, high-pressure steam turbine, which can be seen in our illustration, was also shown. Despite the advance of the gas turbine it is considered that the flexibility and adaptability of the steam turbine have not, as yet, been fully utilised, and research to this end is being actively pursued by Pametrada. To obtain higher efficiencies steam turbine development continues to move in the direction of higher temperatures and pressures, and this is linked with the availability of suitable materials and the use of austenitic steels for a number of components. An experimental unit, known as "Pamela," has been designed to gain experience with steam having a high temperature and pressure, and to study the performance of the special materials used, particularly the effect of thermal stressing and distortion of the austenitic steel casing under changes of temperature.

The unit is a six-stage impulse turbine, representing the high-pressure cylinder of a three-cylinder turbine developing 3000 s.h.p., and passes 30,000 lb of steam per hour at 1100 deg. Fah. and 1100 lb per square inch. For the rotor, which is a hollow forging, G.18 B. material has been used, and F.C.B. steel for the casing, while the blading material is one-third Bimonic 80, one-third G.18 B., and one-third F.D.P. The power developed, 1650 s.h.p. at 8900 r.p.m., is measured by a torque meter and is absorbed by a two-row turbine driven in reverse. Exhaust steam from the driving turbine is used by the steam brake and the temperature of the steam when leaving the brake is such that a desuperheater is incorporated in the exhaust line in order that the steam may be condensed in a surface condenser. A water-cooled framework surrounds the turbine to permit the taking of distortion measurements and steam is supplied at 1200 lb per square inch and 950 deg. Fah. by a Foster Wheeler boiler and then superheated to 1100 deg. Fah. in an oil-fired, second-stage superheater.

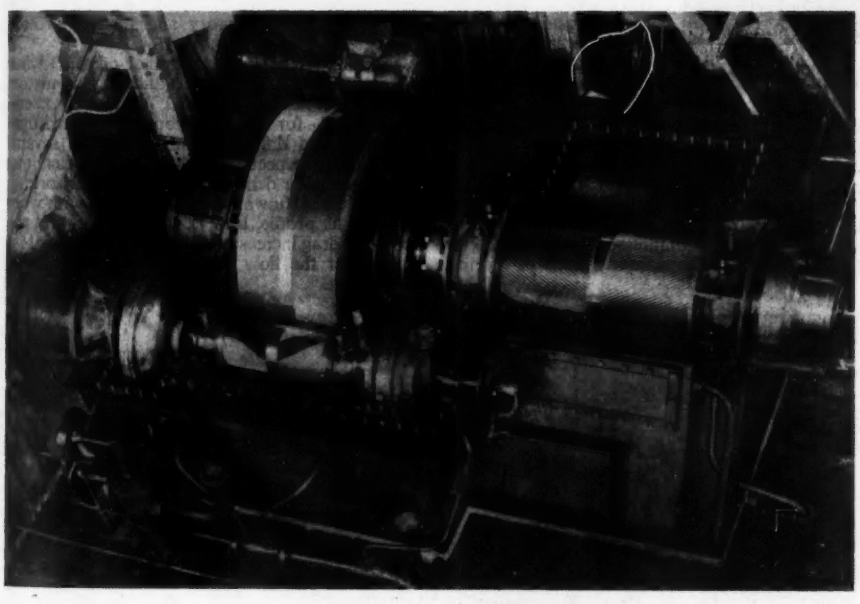


Experimental H.P. Steam Turbine

Work on marine gear testing continues by the back-to-back method, in which the circulating torque is produced, measured and changed by a Pametrada hydraulic torque loader, and the power to overcome friction losses is supplied by a small turbine. At present there are on test two double-helical, single-reduction gearboxes of steam gunboat pattern in which the materials are En 26 for the pinions and En 19 for the wheels. Other back-to-back gear trials are in hand to obtain data upon the various combinations of gear steels and of tooth forms under service conditions up to point of failure.

Diagrams showed the effect of the length/diameter ratio on the performance of journal bearings, based on the results of a series of experiments, using length/diameter ratios ranging from unity down to one-eighth, in which measurements were taken of bearing losses, oil flows and overload capacities. The optimum ratio appears to lie between two-thirds and one-third, depending upon service and tests using a half-bearing fitted with thermistors, as shown in our illustration, were carried out to determine the temperature distribution around the shells of the shorter bearings. The results showed the influence of alignment, and that the hottest point varied with running conditions and did not necessarily coincide with the load line. Other tests were concerned with chambered bearings, which were shown to be tolerant of a greater quantity of heat than plain bearings which had a better performance under normal conditions because the greater oil flow in chambered bearings caused them to run cool and so increased friction. The effect of surface finish upon the lubrication of bearings is being investigated and also the problem of oil film distribution, while the possibility of lubrication by other media has been considered. With regard to this last item, a pneumatic bearing has been designed and incorporated in an experimental turbine now under test.

Bearing Temperature Research



Gas Turbine Reversing Gearbox

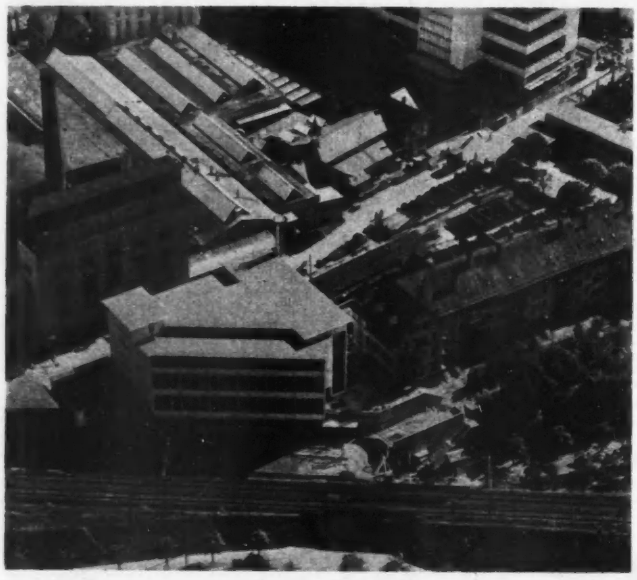
The Fire Resistance of Wood.—We have received from the Directors of the Fire Research Organisation of the D.S.I.R. a revised bibliography containing nearly 600 references of literature about wood and its relation to fire, including fire retardant treatments.

Lloyd's Wreck Returns.—Lloyd's Register of Shipping has published a statistical summary of merchant ships totally lost or broken up during 1952. The world total of steamships and motorships lost consequent upon casualty amounted to 181 ships of 219,429 tons gross, including 19 ships of 10,656 tons owned by Great Britain and Northern Ireland and 23 ships of 14,279 tons belonging to the other Commonwealth countries. The corresponding returns for steamships and motorships condemned or broken up, not consequent upon casualty, are respectively 435 ships of 736,356 tons gross, 136 ships representing 299,200 tons and 24 ships of 15,719 tons. A tabular statement records the ships lost through casualty, by the principal maritime nations, for each year since 1928.

Fluid Dynamics and Combustion Research Laboratory at Baden

To house in one building all aspects of fluid dynamic and combustion research, Brown Boveri and Co., Ltd., has commissioned a new laboratory building. Some of the equipment is described here.

RECENTLY we visited the works of Brown, Boveri and Co., Ltd., at Baden, Switzerland, on the occasion of the inauguration of its new fluid dynamics and combustion laboratories. The building is shown in our first illustration, and, as with the extension to electrical component and turbo compressor factory, which



Fluid Dynamics and Combustion Research Laboratory

can be seen also in the upper left hand corner of that illustration, its vertical development, both above and below ground level, was dictated by the restricted area of the site available to the company. The new structure has three basement floors constructed in reinforced concrete, the lowest floor being arranged as a cable room and housing the instrument transformers, the floor above housing the switchgear. The eight transformer and distribution installation cells extend through both these floors. In the top basement floor are some auxiliary machines and pipe-work which serve the ground floor test installations. A hall having a floor of 9m by 24m, forms the combustion laboratory, its height to the crane track being 12·3 metres. The fluid dynamic laboratory occupies the ground and first floors and the top floor is being used for administrative work.

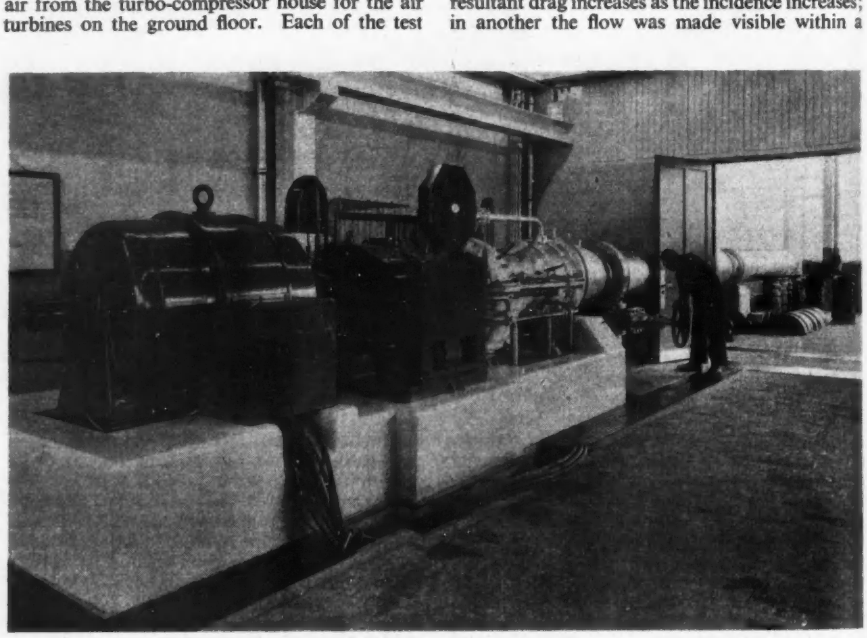
Not all the equipment installed is new, much of it having been merely transferred there from different places dispersed on the site. One such piece of equipment is the supersonic wind tunnel, made and designed by the company a few years ago. It is a closed circuit tunnel with a working section of 31 square inches, and can operate with Mach numbers up to 2·5. The lower flow section of the tunnel is situated in the top basement floor and includes the circuit air cooler, the cooling air fan for the 750kW driving motor, and an 800kW converter set. The upper half of the circuit, shown in another of our illustrations, appears on the ground floor. The working air of up to 6 cubic metres per second, with a pressure ratio of 3·3, is supplied by an axial blower which is driven by the 750kW d.c. motor through a dynamometer. This blower also serves as a blade research installation. So that the tunnel may work at sub-atmospheric pressures, a vacuum pump is connected to the circuit. The test section of the tunnel is housed in a special measuring and computer room, together with Schlieren apparatus.

The company has for some years now been working with this tunnel on the phenomenon of self-excitation which occurs with blades in cascade, when placed in a constant velocity air stream, some of its work with this problem having beeen published. This phenomenon was demonstrated during our visit, and it formed one of several interesting demonstrations of more well-known flow characteristics which were chosen to illustrate the facilities provided by the equipment. In this particular case, the geometry of the blades and cascade were chosen such that the demonstration might be readily effective with the speeds available in the tunnel. It was first performed with natural and then with stroboscopic light. As the flow was increased, the blades began to deflect, until with the attainment of a critical speed, they vibrated at near their critical speed but out of phase, so that adjoining blades struck each other. With further increases of air speed, these purely flexural deflections decreased and at another critical speed flutter was established, these two forms of deflection not being connected as with the case of the aeroplane wing.

The greatest part of the first basement is taken up by the distribution and return system of the air from the turbo-compressor house for the air turbines on the ground floor. Each of the test pits can be connected to either one of the two compressed air lines and to the return line in the centre. As the air turbines are also connected in the turbo-compressor circuit, each turbine has a 300kW air heater fitted at the inlet and an air cooler fitted in the return line to the turbo-compressors. A vacuum pump is also connected in the system for the air turbines. Separated from the main part of this basement is a dark room for photographic work, at present one impulse and two reaction turbines have been erected on the test pits, all driven by compressed air. For torque measurements, the three machines are fitted with Brown Boveri hydraulic brakes and Busch balances. The impulse turbine is designed to run at 10,000 r.p.m. with a maximum capacity of 400kW ; different shafts with wheels having one or two rows of blading can be fitted. The nozzle profile and radial width, as well as the arc of admission can be varied over a wide range. The clearance between the nozzles and the rotor blades can be adjusted between 0mm and 16mm during running. For measuring axial thrust, pressure, temperature and angle of flow behind the rotor, special devices are provided. The first reaction turbine is built to run at 10,000 r.p.m., and has a 700kW capacity ; the central part of the cylinder can be changed, thus enabling the blade height and the number of stages to be adjusted. The second reaction turbine is used for the more delicate investigation of flow behaviour at the blade tips and in the blade clearances. Blades of any dimensions can be fitted, particularly cascades of different axial pitches.

The wind tunnel driving motor and the motors of the blowers in the compressor house can be controlled from control desks at the test stations. In the compressor house are three compressor sets, two of which are driven by variable-speed 750kW d.c. motors, while the third is driven by a 1200kW a.c. motor. A 1500kW converter supplies the d.c. current. When running in parallel, the three blowers have an intake of 10 cubic metres per second and a pressure ratio of 4 ; when sets 1 and 2 work in series, they handle 2·3 cubic metres per second with a pressure ratio of 16. The switchgear for the driving motor is accommodated near the passage connecting the laboratory and the compressor house.

On the first floor are a number of small wind tunnels with air flows of 2·5 and 5 cubic metres per second. They are used for model experiments and for investigations on centrifugal impellers and diffusers, and with them several well-known aspects of fluid flow behaviour were chosen for demonstration. In one working section it was shown, using an aerofoil with wool tufts on its profile, how flow separation and the resultant drag increases as the incidence increases; in another the flow was made visible within a

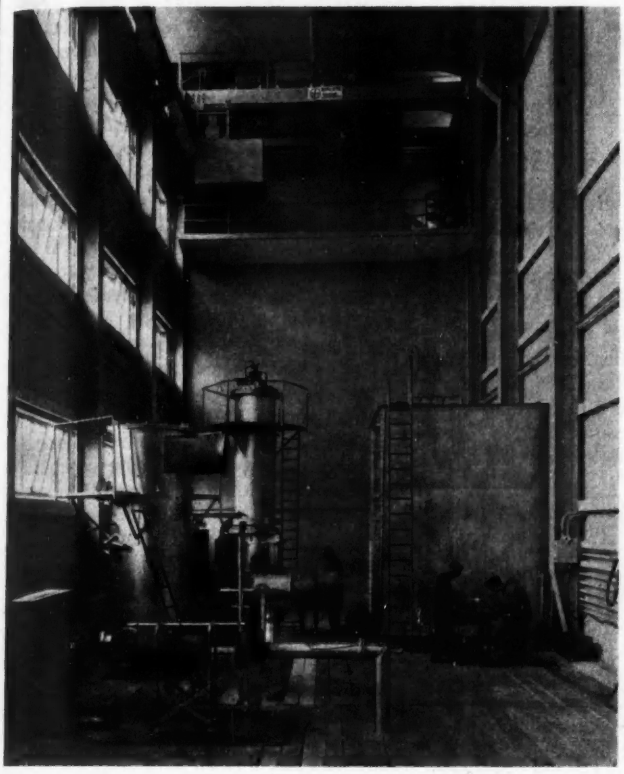


The Supersonic Wind Tunnel

"Plexiglass" chamber such that the eddying nature of the flow was illustrated when its direction was changed without the use of deflector plates across the section.

Combustion

Research in the combustion laboratory is proceeding on three broad fronts. The developments include highly-loaded, durable combustion chambers, which will burn many kinds of solid, liquid and gaseous fuels completely and smokelessly over the whole range of regulation, whereby combustion will be mostly under pressure; combustion with little excess air in pressure-charged steam producers, and for gas turbines, the homogeneous mixing of hot gases of combustion with cold air. Influencing the combustion to convert the fuel ash into a harmless form in which it will neither attack the material nor choke the passages is the subject of research.



Part of the Combustion Laboratory

A certain amount of fundamental research on specific problems is to be carried out. The company feels, however, that because of the complex influence on the combustion process of the many variables, such as velocity, density, viscosity, dimensions and surface roughness and the thermal and chemical properties of the components and products of combustion, it is unwise to try and establish corresponding laws for models and to carry out experiments on a reduced scale. In consequence, it is intended to make most experiments with full-size combustion chambers. This consideration formed one reason for the unusual height of the combustion hall; in it, it is considered that the future sizes of combustion chambers can be accommodated, and it facilitates the handling of prototype chambers, and enables coal hoppers to be accommodated for firing experiments with coal. Part of the hall and some open and closed combustion chambers are shown on this page. Arrangements have been made for the provision of temporary working platforms at various heights of the hall.

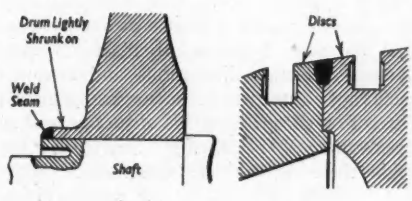
On the first basement floor of the combustion laboratory there are few pipes below the test room, so that prototypes or combustion chambers can be erected which extend down into the basement. Two inlet ducts for combustion air can either be fed with high-pressure air from the turbo-compressor house or with low-pressure air from the two blowers of 10 and 5 cubic metres per second capacity housed at the far end of this floor.

The exhaust gases are cooled to at least 300 deg. Cent. by means of water sprays. At the front of the basement, four liquid fuel tanks are located in a fire-proof room, which also contains the high-pressure liquid fuel pumps, the fuel preheaters, including filters, and the distributing battery of valves. For testing the efficiency of oil atomisers, a boiler feed pump supplies the necessary high-pressure water.

On the ground floor the following installations have so far been provided above the four covered pits of the combustion laboratory: a stand for production testing fuel atomisers, experimental equipment for investigating fluid flow in combustion chambers (including transparent insert, nozzle for water jet and illumination for photography), also another combustion chamber for actual combustion experiments, and finally, testing apparatus for experiments on corrosion and ash deposit problems on gas turbine materials. As already mentioned, it is possible to erect fairly large machine sets on the pits, so that experimental gas turbines, pressure-charged gas producers and similar machines can be tested over lengthy periods.

One of the demonstrations in this laboratory concerned the company's ejector system, which consists of two concentric nozzles capable of relative axial displacement. This is used in conjunction with a constant fuel pressure supply of 30 atmospheres. Another demonstration, using wool tufts, illustrated the double vortex achieved in the combustion zone by the system of tangential swirl vanes developed. A methane burner, which the company has developed, was also demonstrated, and on another ingenious rig the separate effect of such parameters as air and fuel rates, inlet swirl, type of fuel, were shown, assisted in this case by an optical system.

The company has also in hand a blade cooling programme, and at the moment is using blades drilled spanwise for water cooling with temperatures of up to 1500 deg. Cent. Another interesting item was the demonstration of a pyrotechnic water injector. This unit is used to administer a brief thermal shock to the turbine blading to effect descaling without shutting down.



Details of Rotor Fabrication

The unit, which is located upstream of the turbine, consists of a water filled barrel loaded with a cartridge; when detonated, water is discharged through a nozzle, forming an extremely fine spray, thus cooling an axial element of the gas flow.

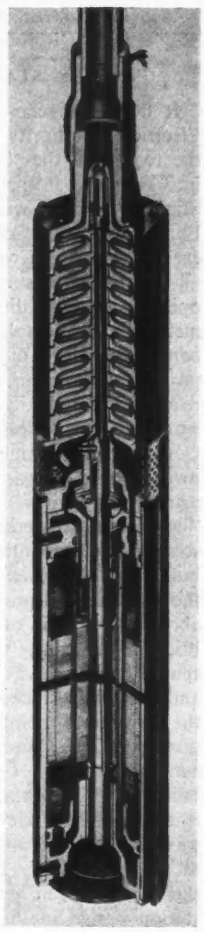
Works Tour

During the visit, the guests of the company were conducted on a tour of the production departments. Amongst many items of interest were the methods of fabricating the rotors which this company has employed for some time. Our illustration shows two methods of welding by which this fabrication is achieved. One advantage claimed for the system, apart from any production considerations, is that all the component parts lend themselves to methods for reliable flaw detection.

During the tour, the guides were equipped with portable self-contained microphone and loud speaker equipment, and their remarks were clearly audible in the noisiest environments.

A ½ H.P. Submersible Pump

A unit which is claimed by the makers as being the smallest and cheapest submersible electric water pump developed commercially has been introduced by Sumo Pumps, Ltd., 28, St. James's Square, London. It is illustrated below and consists of a multi-stage centrifugal pump driven directly by a squirrel-cage induction motor of ½ h.p., the whole forming a capsule of less than 4in diameter and weighing 32 lb. The capacity of the pump ranges from 400 gallons per hour against a 30ft head to 100 gallons per hour at 100ft head. The unit is ideally located vertically and suspended from the end of the delivery pipe, but it can be operated in any other position.



Submersible Pump

To protect the field coils of the motor when running submerged the system of sealing completely the stator within a thin stainless steel tube has been adopted. The rest of the pump runs "wet," the rotor bearings being water lubricated and protected from sand or grit infiltration by labyrinth seals. A Michell thrust bearing, which is also water lubricated, is fitted between the pump inpellers and the motor shaft. The motor shaft is of stainless steel and all the bearings are bronze bushed.

There are nine centrifugal stages, which are identical, the diffuser rings and casings of each stage being bolted together to form the body of the pump. Both the impeller and casing units are bronze die castings, with waterways and aerofoil section interstage guide vanes.

International Conference on the Complete Gasification of Coal.—The Institut National de L'Industrie Charbonnière, 7, Boulevard Frère-Orban, Liége, Belgium, is organising an international conference, to be held in Liége from May 3 to May 8, 1954. The conference will discuss the complete gasification of coal, and it is expected that well-known engineers from a number of countries will submit papers. The conference will take place at the same time as the yearly industrial fair at Liége, and it will be followed by visits to the principal gasification plants of Western Europe.

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POWER STATION DESIGN

It does not seem likely that the British Electricity Authority will be very excited by the report of the "Committee of Enquiry into Economy in the Construction of Power Stations," which was published last week. For though the Committee does not see exactly eye to eye with the Authority upon all points there is no head-on collision of opinion and even divergencies of view seem merely those of emphasis. Nevertheless, as a concise discussion of trends of thought about power station design, the report is well worth reading. Paradoxically it is all the more worth reading because at the very outset the Committee takes much of the wind out of its own sails! It was appointed with "the primary objective" of securing economies "in building materials and building labour so as to minimise interference with the house-building programme." But it points out that the 1952 B.E.A. programme absorbed only about 1 per cent of the annual output of bricks, 2 per cent of that of cement and 1 per cent of building and civil engineering labour; and that while, indeed, some 16 per cent of the structural reinforcing steel available during 1952 was absorbed the availability of such steel does not materially affect home building. The Committee's discussion has thus little or no relevance to the problem it was intended to examine! In our view it is all the better for it. For the conclusions that there have been extravagances in power station design in the past and that further economies can be attained in the future are reached upon much more fundamental engineering and architectural grounds than those of securing economies only in bricks and mortar.

We do not think there is much in the Committee's discussion of the design of plant and equipment with which the B.E.A. or engineers in general are likely strongly to disagree. Much of it, indeed, follows lines parallel to those of the Report of the U.S. Productivity Team on the British electricity system. The Committee welcomes the decisions of the Authority to base future plans on larger units than heretofore, generating up to 100,000kW without and 120,000kW with reheat, and its decision that all new stations should be of unit design. But it is convinced—and so, we think, is the B.E.A.—that there is "wide scope for simplification and standardisation both in layout and still more in design of equipment." Can it, indeed, be doubted? Under the Authority's plans for expansion somewhere in the region of 100 sets will have to be manufactured and installed within the next eight years, the exact figure depending upon the outputs of individual sets; and since demand for electricity is tending to double about every ten years, the rate of manufacturing new plant is likely further to increase. When there are so many sets to be made it is obvious that important economies could follow from simplification and standardisation, not only of plant and equipment, but of the building and layout of power stations themselves. It is, indeed, so obvious that it becomes all the more needful to stress that some flexibility should be left so that turbo-alternator builders and boilermakers will be able to experiment with and prove the abilities of advanced designs. Moreover, particularly in boilers, design is still in many respects fluid and is, in any case, as the Committee recognises, heavily influenced by the nature of the coal available; and even the design of turbo-alternators is still very far from static. It may, indeed, be less "obviously inefficient" than it appears, upon a view restricted only to economy in cost of British power stations, that the several makes of machines each demand different dimensions and arrangements of foundations, pipe arrangements, &c. For competition has virtues as well as disadvantages. Leaving heavier plant aside there is, as the Committee points out, plenty of room for standardising at least the leading dimensions of much auxiliary plant and certain constructional works, such as chimneys. Moreover there are other factors besides simplification and standardisation that could lead to economies. The Committee, for example, discusses what should be the number of units installed in each station and points out that the greater the number of units installed in each station the less becomes the difficulty of finding and securing suitable sites. That is a point which we think has already been appreciated by the Authority now that few remaining sites are available with sufficient river cooling water and more use must be made of cooling towers.

When it turns to the consideration of power station buildings rather than plant, the Committee begins to discuss questions that are of interest to a wider public than engineers alone. For our part we find much to applaud in what it has to say, even though it often reflects, in saying it, views already accepted by the B.E.A. In particular it is critical of the "monumental" character of many modern power stations and it points out that the Royal Fine Arts Commission, which has often been blamed for favouring such a treatment, has in fact repeatedly criticised it. We applaud, too, its forthright remark in relation to Bankside power station that "such a site is from the town planning point of view fundamentally wrong," however desirable it may be on purely technical grounds. The Committee would have the Authority appoint architects "with open minds and allow them to experiment with new techniques in meeting the problem of giving æsthetic expression to the function and construction of the buildings." It believes that large economies could result from a reduction in the volume of covered space in power stations without sacrifice of architectural appearance. Lastly, in discussing methods of carrying out construction and installation, it suggests that while "it is obviously for the Authority to carry through necessary research, and to digest the results for general assimilation. . . . the greatest efficiency of Divisional activity would be secured if the Authority at the centre were to set targets, and lay down standards for cost, area, space, time of construction; and thereafter leave the Divisions, where technically and administratively qualified, full freedom to work within these limits." That is a point well worthy of the Authority's consideration.

THE COLOMBO PLAN

This week the Council of the Colombo Plan nations has been meeting to review progress made since the Plan was formulated. The Colombo Plan, it will be recalled, is one devised within the Commonwealth to help along the development of the more backward nations in South-East Asia. It is an affair in which highly industrialised nations like Britain, Canada and Australia, Commonwealth countries such as India, Pakistan and Ceylon and other countries which are not even within the Commonwealth, like Burma and the East Indies, are co-operating to facilitate the carrying out of great projects for improving agriculture and extending industrialisation. That the plan should be successful is of high importance for the human race. For, thanks very largely to advances in the science of medicine which have reduced the death rate, the populations of the nations of South-East Asia are expanding rapidly. A situation has thus been created which is immensely stimulating to engineers. For though something can be done to educate the inhabitants towards improved methods of agriculture and not a little by small scale schemes of drilling new

wells and improving water supply in arid areas, basically the situation can only be relieved by the construction at speed of great engineering works designed to bring vast new territories under cultivation, to convey the products to their markets, and to generate power and thus increase the productivity of each man's labour.

It is an unfortunate economic fact that it is very difficult for really backward countries to help themselves to higher living standards. Amongst highly developed Western nations it is a matter of choice for their peoples whether to enjoy immediately higher standards of living or whether slightly to hold down standards and to divert resources to the production of capital goods and thus ensure continuously rising standards in the future. But they can do so only because their peoples normally live at standards far higher than those of mere subsistence. By contrast in ill-developed countries there is not only a lack of technically trained men, but also any attempt to divert labour to the making of capital goods necessarily reduces food supplies and threatens to reduce already low standards of living towards a starvation diet. Only a dictatorship such as existed in Russia from 1918 onwards can dare to adopt so ruthless and inhuman a policy. Thus, if the expanding populations of South-East Asia are not to starve, financial aid must come from the developed nations of the West. The aid thus made available can be spent not only upon importing machinery and the like, but also upon obtaining food in the interim until some great schemes of irrigation have come to fruition. So far the very considerable works under construction under India's well-publicised Five-Year Plan and Pakistan's National Development Plan, 1951–57, and in Ceylon and Burma (including the great Chainad dam project, which will cost £21,000,000), and in many other S.E. Asian countries, have been financed out of releases of sterling balances amounting to about £250 million ; contributions from Australia, Canada and New Zealand reaching nearly £50,000,000 ; loans from the International Bank of over £50,000,000, and aid from the United States under its Point Four programme of about £100 million. Thus, some £450 million is already committed. But if all the many projects that have been started are to be completed and all those that have been planned or are in course of being planned are to be carried out much more will be needed. If British consultants are to design a proportion of those works and oversee their construction and British firms are to manufacture equipment, Britain will need to continue to contribute into the future. Whether or not it will be able to do so will depend upon the willingness of people in this country either to produce more or to forgo consumption.

It is sometimes held that by exporting technical knowledge and capital goods this country, which is so heavily dependent upon selling exports to the world to make a livelihood, is laying up troubles for itself in the future by making it possible for other nations with lower standards of living to make for themselves goods that are now exported to them. It is, of course, an argument that runs counter to the whole conception of the Colombo Plan, which envisages increasing industrialisation of the areas it covers. But it is also an argument with some force behind it. For undoubtedly industries producing consumer goods, and even some producing capital goods, have in the past and will again in the future find their markets restricted by the production abroad of the goods they make. But those who hold to the argument seem to us to lack courage and to lack faith in British skill. This country's industries do not only sell to under-developed countries. Some of their best markets are found in the richer, more highly developed, lands, and if duties were lowered and customs procedures eased, this country might even find the United States, the richest and most highly developed country in the world, to be also the best market for its exports. Raising living standards in South-East Asia, which is the object of the Colombo Plan, must necessarily increase the demand of that area upon the productivity of the West. It must also increase the ability of the area to pay for the things it demands. Certainly if standards of living in the East can be raised the pattern of Eastern demand will change. But surely British industry has the skill to reap an advantage from the change ? Politically, if only to prevent the area becoming dominated by Communism, it is desirable for the West to enrich the East. But industrially self-interest goes hand in hand with political expediency. Raising living standards in S.E. Asia will provide new and very great markets to absorb the productivity of the West. We do not see that British industries should fear the outcome.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

THE " SONIC BOOM "

SIR,—The succession of loud " booms " or " bangs " heard in the vicinity of fast-flying aircraft has frequently been mentioned in the press. It was mentioned in your leading article of August 14th. Its origin is usually regarded as some complex phenomenon. As one who has never heard a sonic boom, the writer is perhaps especially unwise to suggest that the explanation may be quite simple.

If the sound waves emitted by an aircraft engine in the direction of an observer are received by him during a period much shorter than that over which their emission was spread, he hears a louder sound than if the aircraft were stationary in relation to him. He hears a " bang " if the waves generated over a period of a few seconds reach him simultaneously, or a less strong " boom " if arrival is not quite simultaneous. Simultaneous arrival is effected by all waves emitted during any period in which the velocity of the aircraft in the direction of the observer is equal to the sonic speed. The simplest case, analytically, is that of an observer on the straight flight-path of an aircraft moving uniformly at the sonic speed. The waves that the engine directs along the flight-path do not get away from the aircraft and (with normal dissipation due to spread from the point of vision) they all reach the observer simultaneously ; he receives a boom and an aircraft all at once.

If the observer is safely offset from the flight-path he will hear no " sonic boom " at all unless the speed of the aircraft exceeds that of sound, because its velocity in his direction is always less than its velocity along its path in the ratio of the cosine of the angle between those directions. The waves emitted in the direction of the observer during any interval over which the product of speed and cosine approximate to the sonic speed will be received by the observer in a time much shorter than that of generation and he hears a " boom." An observer offset from the straight path of an approaching aircraft accelerating at supersonic speeds may hear two booms. The first one originates when the product of the speed of the aircraft and the cosine of the angle between its path and the direction of the observer first approximates to the sonic speed. As the aircraft proceeds the cosine diminishes and however fast (or slowly) the machine subsequently flies, the product of its speed and the cosine will sooner or later again become (momentarily at least) equal to the sonic speed. This is certain because the cosine comes down to zero when the line joining aircraft and observer is perpendicular to the flight-path. If the product of velocity and direction-cosine changes slowly past the sonic speed, the observer will hear a boom ; if the change is rapid the boom may be unnoticeable. The speed of the aircraft may happen to rise in such a way that its product with the direction-cosine remains sensibly equal to the sonic speed for an appreciable period. The observer then hears a boom of strength determined by the length of that period, for its effect on him is concentrated into a very short time. The possible variations in the value of the product of velocity and direction-cosine for an aircraft moving with varying velocity in a curved path are infinite and so it is physically possible for an observer to hear a wide variety of successions of booms originated by the one aircraft.

If this explanation of the origin of sonic boom is correct, they are not associated with the actual passage of the aircraft through the so-called sonic barrier. Because the direction-cosine is always less than unity, a boom can be originated only by an aircraft flying at a speed higher than the sonic speed. Observers at a common distance from the straight flight-path of an aircraft at constant supersonic speed will hear similar booms, each after the aircraft has passed its nearest position to him. Observers at a greater distance will hear lighter booms. In general, however, observers of an aircraft flying at varying speed on a curved path will hear different sounds from it. Some will hear a boom or booms and some will not, and it is to be expected that different observers may give widely divergent reports of the booms they heard from the same aircraft on the same occasion.

W. A. TUPLIN

University of Sheffield,
September 12th.

PRESERVATION OR ENHANCEMENT

SIR,—Your leading article of October 9th poses several questions and therefore invites answers. For the most part it purports to deal vaguely in generalities, whereas its true intention appears to be the advocacy of bit-by-bit industrialisation of the national parks, a process which, it suggests, may enhance the present state of beauty of these parts. I am sure that no unbiased person who has been familiar beforehand with areas of natural beauty recently affected by industrial development could feel that the most beautiful portions have been enhanced. Some of the less interesting areas, for instance, of Scotland, may have been changed somewhat for the better ; but both in the British Isles and on the Continent on the whole the pre-existing (and predominantly natural) beauty has been diminished, and sometimes it has been completely ruined.

Our national parks are small areas where, and where only, there exist special types of scenic beauty. It may almost be said that they are the remnants of beautiful Britain. Over the rest of the country the industrialisation essential for supporting our dense population has for the most part already been developed, and the effects on scenery are there for all to observe, though

familiarity tends to mitigate the impact on the observer.

The engineering works of man are essential, and sometimes have a beauty of line and form, as well as the more recondite beauty of function which undoubtedly tends to obsess engineers. But, for our small—very small—remaining areas of yet unspoiled scenic beauty, let us preserve them from our engineers, Ministries and scientists. Such areas may perhaps have been more beautiful in the past ; but let us ensure that there is no risk from zealous and enthusiastic industrialists of our national parks being any less beautiful in the future than they are as we know them now.

KENNETH H. LEECH
M.I.C.E., M.I.Loco.E.

Chippenham, October 9th.

THE " BRITANNIA " LOCOMOTIVES

SIR,—I am glad to see that, when the fireworks have subsided, Mr. Nock and I seem to be in complete agreement in principle that the so-called excellence of the performance of these locomotives in East Anglia is in fact based on comparisons with considerably smaller machines. Whether you present the " Britannias " in the most unfavourable light by giving the discrepancy in size as 25 tons in 94½ tons by comparison with " B.12s " (rebuilt, of course), as I do, or on the most favourable terms as 20 tons in 143 tons by referring to " B.1s " or " K.3s," and then adding the weights of the tenders on both sides, as Mr. Nock does, is mere jugglery with figures which does not alter this fact.

Whilst the dates of introduction of the " B.17 " and " B.1 " classes given by Mr. Nock are well known, I would like to query his statement that the " B.12 " class as rebuilt with larger boilers and long-travel valves then ceased to be first-line express engines. It is my impression that neither the " B.17s " nor the " B.1s " entirely replaced these particular " B.12s " (to which the weight of 69½ tons given in my comparison with the " Britannias " will be found to refer) ; as late as 1948 I personally travelled behind them on two Liverpool Street express workings picked entirely at random. So long as a proportion of these engines were on regular express workings, is it not reasonable to suppose that even British Railways would arrange schedules to suit them, and not for the slightly larger " B.17s " or " B.1s " sharing these duties, thus leaving my original comparison a valid one ?

R. G. B. GWYER

Manchester, October 9th.

Books Received

Lubricant Testing. By E. G. Ellis. Shropshire : Scientific Publications, 8, Walker Street, Wellington. Price 37s. 6d.

Engineering Directory. Bristol : Bristol Engineering Manufacturers' Association, Ltd., 16, St. Stephen Street, Bristol.

Vermuyden and the Fens. By L. E. Harris. London : Cleaver-Hume Press, Ltd., 42A, South Audley Street, W.1. Price 21s.

Physics. Vol. I. London : Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, W.C.2. Price 21s.

Tool Engineers' Data Book. By Gerhard J. Gruen. London : Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 44s.

The Instrument Manual. Second edition. London : United Trade Press, Ltd., 9, Gough Square, Fleet Street, E.C.4. Price 84s.

Welding, Brazing and Metal Cutting. By E. Molloy. London : George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Price 15s.

Electric Resistance Heating. Electricity and Productivity Series, No. 5. London : British Electrical Development Association, 2, Savoy Hill, W.C.2. Price 9s.

A History of Railway Locomotives Down to the End of the Year 1831. By the late C. F. Dendy Marshall. London : The Locomotive Publishing Company, Ltd., 88, Horseferry Road, S.W.1. Price 50s.

Iron and Steel Institute in Holland

No. I

From September 30th to October 7th members of the Iron and Steel Institute paid a visit to Holland. In this article there is a general introductory survey of Holland descriptive of its dykes, its major cities and some of its industrial activities. A following article will mention in more detail the activities of the members of the Institute and include some description of the works visited.

HOLLAND, to which the members of the Iron and Steel Institute paid a visit between September 30th and October 7th, is primarily associated in English minds with dairy products, flowers and those Dutch bulbs which gladden our gardens in spring and summer. But as the members discovered, Holland is also a country of high and growing industrial importance relative to its size and population. Geographically it owes its importance to its situation. The southern part of the country lies astride the combined deltas of the Rhine and the Meuse, waterways that have for very many centuries brought the produce of central Europe to the coast. Northwards there is easy sea access to the ancient Hanseatic cities of Germany and the countries of the Baltic. It was that ease of access to the

Fig. 1—Map of Holland

North Sea and the Baltic via the Zuyder Zee that no doubt led to the foundation of Amsterdam on the Amstel River, that delightful city (Fig, 2) which was the headquarters of the Institute during its visit to Holland and which is the commercial capital of the country.

It is, of course, well known that about a half of the land surface of Holland lies below sea-level. But it is less well realised that not all protection from the inroads of the sea is man-made (Fig. 1). From the Hook of Holland at the mouth of the Niewe Waterweg, the waterway that leads inland to Rotterdam, northwards to Den Helder, opposite Texel Island, there is a line of natural sand dunes standing so apparently high above the country behind them that they are sometimes called, derisively, the " Dutch Alps." At one time, it is believed, that line of dunes extended unbroken along the islands of Texel, Vlieland, Terschelling and Ameland, which flank the northern coast. But at some period in the remote past, probably in consequence of just such a surge in the North Sea as led to the flooding of the English coasts and many of the Dutch islands last winter, the sea broke through the protecting lines of dunes and drowned all the land within the Zuyder Zee. But, of course, the line of dunes only gave protection from the inroads of the tides. Behind it much of the area, being insufficiently drained, consisted of meres and marshes. Historically, therefore, and right up to modern times, the Dutch have been engaged in draining those areas. In their journeyings by coach the members of the Institute travelled, for instance, over a great polder to the south-west of Amsterdam which until the nineteenth century was largely under water and known as the Haarlemmermeer. Amsterdam's airport, Schipol, is built within a corner of it. Similar sheets of water, still undrained, are still to be seen in other parts of the country, for example, to the west of Hilversum. Everywhere the drainage of such areas was and is carried out by much the same system. A dyke and a canal are constructed surrounding the area to be drained ; as the water is pumped out drains are constructed to carry rainwater into ditches which themselves carry the water to pumping plants that lift it into the surrounding canal. Sometimes sand from the dunes is pumped in to lighten what would otherwise be heavy, peaty soil. At some suitable place further pumps lift the water into a more important canal at a higher level. Finally, thus pumped by stages, the water reaches a major canal or an embanked river, whence it can pass out through sluices at low tide into the sea or a river estuary. When the members visited the works of the N. V. Nederlandsche Kabelfabriek at Alblasserdam on the River Noord east of Rotterdam, they were able to see, as they drove along the top of the dyke, how surprisingly far below high tide level the level of the land stands in that area. They looked into the second floor windows of houses built against the dyke and over the roofs of houses lying further back. Last winter, for twenty-four hours during the great North Sea surge, the water in the river lipped the top of the dyke in this area ! At one time the pumping of water was wholly carried out by windmills so that at important junctions of canals at differing levels there might be a whole row of turning sails. But now most of the mills have gone and few of those that remain any longer turn. In their stead there has come electric pumping plant and pump-houses often so small that only the initiated realise what they are.

When it is essential to have so many canals for drainage and when, indeed, waterways therefore necessarily reach nearly all parts it has naturally followed that barge transport plays a large part in the economy of the country. Thus, as between rivers and the major canals, and between major canals and less important waterways, barge locks, often of very large size, are frequently to be found. The historic importance of water transport is illustrated by the fact

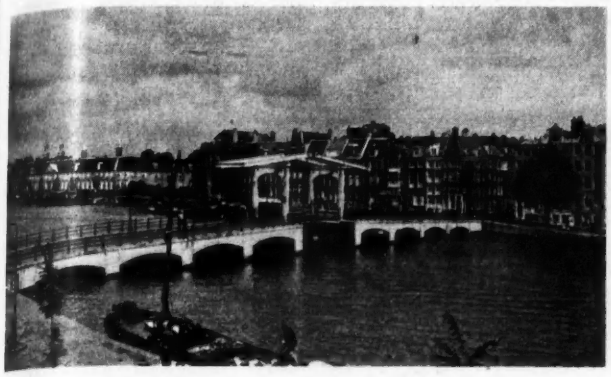


Fig. 2—Amstel River, Amsterdam

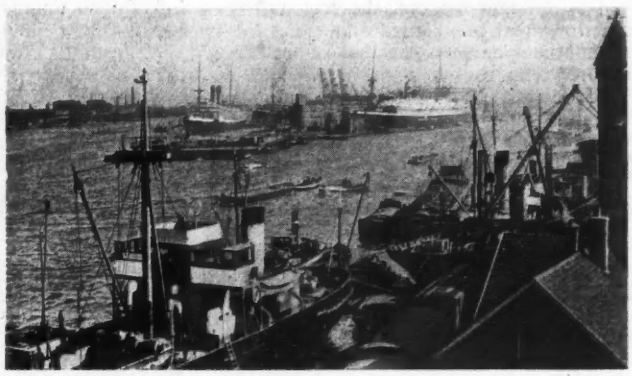


Fig. 3—Amsterdam Harbour

that there seems to be hardly a town or village—at least in the lower lying west of the country—which has not its canals and quays. Nowhere is that point better illustrated than at Amsterdam, whose plan is dominated not by the streets but by a whole series of canals ringing the centre with occasional radial spokes. To-day road and rail compete with the canals for the carriage of goods. Yet to the English visitor the amount of traffic moving along the major canals and waterways is quite astonishing. The floating traffic along the Noord River or through the Merwede canal is about as continuous as lorry traffic on the Great North Road of England and even more varied in size and character !

As we have already remarked, Amsterdam became important in the past—in the seventeenth century it was the largest city in the world—because of its connection through the Zuyder Zee to the North Sea and northern Europe. Later, as world-wide trade was opened up, large sailing vessels were still able to draw up beside its quays. But in the nineteenth century, with the coming of steam and vessels of larger size and draught, difficulty was found in maintaining access from the harbour to the Zuyder Zee. Moreover, Amsterdam is less well situated by nature for world-wide trade than Rotterdam, which lies on the northernmost arm of the Rhine delta. But the citizens of Amsterdam were alive to the danger of a decline of their fortunes. As a first attempt to meet their difficulties they enlarged into a ship canal a drainage canal that runs northwards through Alkmar (famous for its cheese market) to Den Helder at the northern end of that great line of dunes that protects western Holland from the sea. Possibly that canal, the Hollandsch canal, was so sited because some natural fear was felt of breaching the line of dunes if a more direct route had been taken. But later the need to accommodate still larger vessels and to bring them from the open sea more directly to Amsterdam's quays, led to the construction of the great Nord Zee canal whose outlet is at Ijmuiden where there are ship locks over 1300ft long, 165ft wide and 50ft deep, the largest in the world. In addition the great Merwede canal, able to accommodate barges of some thousands of tons capacity, connects Amsterdam to the Rhine via Utrecht. Thus though Amsterdam has long since lost pre-eminence to Rotterdam, whose traffic is now some six times greater, it still remains (Fig. 3) one of the world's great ports and shipbuilding centres. A recent production was the 24,000-ton tanker "Kirkouk." It is interesting to observe that two of the large steel works visited by the Institute are situated on the trade artery that runs through Amsterdam, one at Ijmuiden at the sea end of the Noord Zee canal the other alongside the Merwede canal at Utrecht.

Last winter's great storm breached the sea dykes of Holland in some 300 places. That disaster was so very serious that it seems to have engendered new thinking amongst the Dutch. Before it they had accepted with some equanimity that for economic reasons dykes could be built no higher than they were despite the risk that once in 500 years or so they might be topped. Now there is talk of building a new dyke right across the delta mouths of the Rhine and Meuse. If it is constructed it will be comparable in length and design to the great dyke across the mouth of the Zuyder Zee ; and comparable in cost, too ! But it would, presumably, cost less than the raising of existing dykes which surround the delta islands and extend far inland up the river channels. The Zuyder Zee dyke was completed in 1932. It is 30km long and at the point of final closure a monumental tower has been erected. From its top, on any but the dullest of days, a visitor can look in either direction along the dyke and see it as a narrow strip of land, washed by water on either hand, stretching as straight as an arrow apparently to the horizon. Behind its protection the waters of the Zuyder Zee have been reduced nearly to low tide level and have become fresh instead of salt.

Last winter's disastrous floods here, as in Holland, were caused by the washing away of earthen dykes once they were overtopped. But even were it overtopped the great Zuyder Zee dyke would still stand, restoring full protection to the polders behind it so soon as the tide receded. Members of the Institute, on Sunday, October 4th, made an excursion to Volendam and to the Island of Merken in the south of the Zuyder Zee, some 50km from the great dyke. As they sailed towards the island they were able to see in course of construction, stretching out from each side of the island, dykes which will eventually enclose the island within a great new polder the construction of which, together with others such as the North-East polder, already reclaimed, has been made possible by the existence of the great Zuyder Zee structure, undoubtedly one of the wonders of the modern world. The draining of the polders will add 7 per cent to the land area of Holland and some 10 per cent to its agricultural acreage.

The main interest of members of the Institute lay, of course, in the iron and steel industry of the country. That industry has been and is being built up in spite of the natural disadvantages that few of the raw materials are available within the Dutch borders. That, of course, is the reason why the plants are situated upon main waterways. For along those waterways

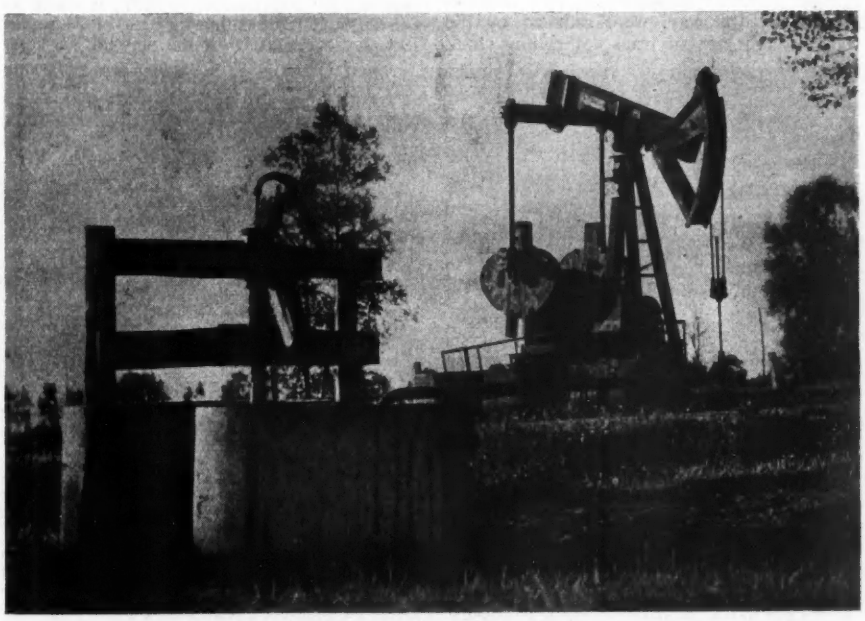


Fig. 4—Pumping Plant in Schoonebeek Oilfield

can be brought the ore, the coal and the limestone that are needed and along them again the products can be shipped for export or for use elsewhere in the country. Production is increasing. The crude steel output per month now approaches and sometimes exceeds 70,000 tons. But Holland is not wholly without natural resources. Its Limburg coal mines, produce rather more than 12,000,000 tons per year. What is less well known is that some 20 per cent of the nation's needs in oil are met from its own resources and that, upon geological evidence, oil is being expectantly sought elsewhere. Test bores are being put down on the outskirts of Rotterdam and members during their travels were able to see a drilling jig under erection within a stone's throw of the ancient walls of Delft. The productive oil field lies far out on the eastern border of the country at Schoonebeek and extends into Germany. On the German side each well is topped by a derrick. But the Dutch have not so disfigured their countryside. The bores are put down by a transportable derrick and when oil is struck pumping plant similar to that illustrated in Fig. 4 is erected. The variable-stroke electrically-driven machines look for all the world like miniature beam engines, and the Dutch have a special name for them. They call them " Yes-Nodders " (" Yes, there is oil—Yes there is oil " they seem to be saying as the beam nods to and fro). The oil is pumped through underground pipes to collecting stations served from several wells and thence to a central treatment plant where the water is separated from the oil and the treated oil loaded into rail wagons for transport to modern refineries at Rotterdam at the rate of about 1000 tons a day. Through the kindness of Davey Paxman and Co., Ltd., we were recently able to visit that oilfield and see, amongst other matters, how much oilfield plant is now being made and supplied by British manufacturers and how arduous, often, are the working conditions it must be built to withstand.

There is much else that an engineer visiting Holland will find of interest. All over the country, for instance, there are to be found counterbalanced opening bridges of the kind illustrated in Fig. 2, some built at least as recently as the late thirties. Why, one wonders, have such structures not proved popular elsewhere ? The railways (which, by the way, were reduced by the war through lack of track, of rolling stock and of other equipment almost to impotence, but have now fully recovered) are equipped with much light-weight electric and diesel stock which is particularly smooth-running, and operate quite intensive passenger and freight services. Of 1994 route-miles, 846 are electrified ; and the total railway staff per 1000 train-miles is only 1·01. There have been substantial working profits each year since 1946. The road system of the country, too, is being rapidly improved. In their travels the members of the Institute were able to see many new double-track roads under construction besides long lengths of such roads already completed. Through war and the loss of possessions in the East Indies the Dutch were much impoverished. But through hard work and enthusiasm they are undoubtedly now modernising and enriching their country.

(To be continued)

R.M.S. " Andes "

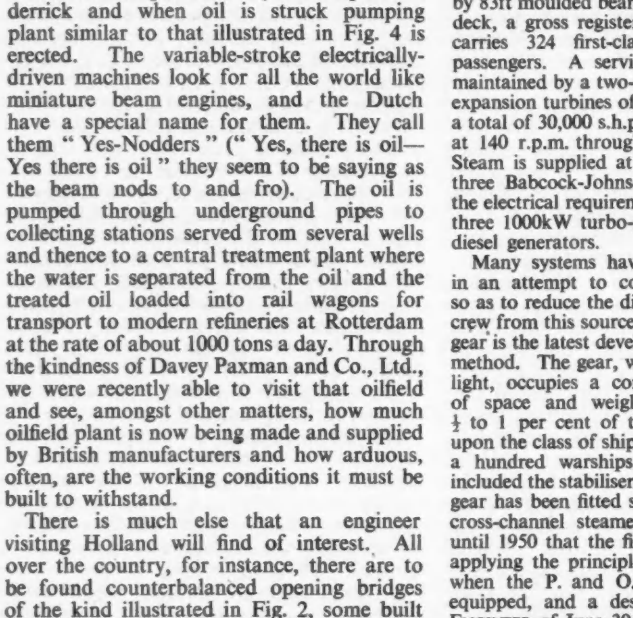
THE " Andes," the flagship of the Royal Mail Lines, Ltd., is the first of that company's fleet to be fitted with stabilising equipment, which is, in this instance, the " Denny-Brown" ship stabiliser, designed and built by Brown Brothers and Co., Ltd., in collaboration with Denny Brothers. The ship is one of the largest to be so equipped and has a length between perpendiculars of 630ft by 83ft moulded beam by 47ft 6in depth to " C " deck, a gross registered tonnage of 25,676, and carries 324 first-class and 204 second-class passengers. A service speed of 21·5 knots is maintained by a two-shaft arrangement of triple-expansion turbines of Parsons design, developing a total of 30,000 s.h.p. and driving the propellers at 140 r.p.m. through single reduction gearing. Steam is supplied at 430 lb per square inch by three Babcock-Johnson water-tube boilers, and the electrical requirements of the ship are met by three 1000kW turbo-generators and two 500kW diesel generators.

Many systems have been evolved and fitted in an attempt to control the rolling of ships so as to reduce the discomfort to passengers and crew from this source, and the " Denny-Brown " gear is the latest development of the activated fin method. The gear, which is relatively small and light, occupies a comparatively small amount of space and weighs approximately between ½ to 1 per cent of the displacement depending upon the class of ship, speed and stability. Over a hundred warships, mainly destroyers, have included the stabiliser in their equipment, and the gear has been fitted successfully to a number of cross-channel steamers. However, it was not until 1950 that the first step was taken towards applying the principle to large passenger ships, when the P. and O. liner " Chusan " was so equipped, and a description appeared in THE ENGINEER of June 30, 1950.

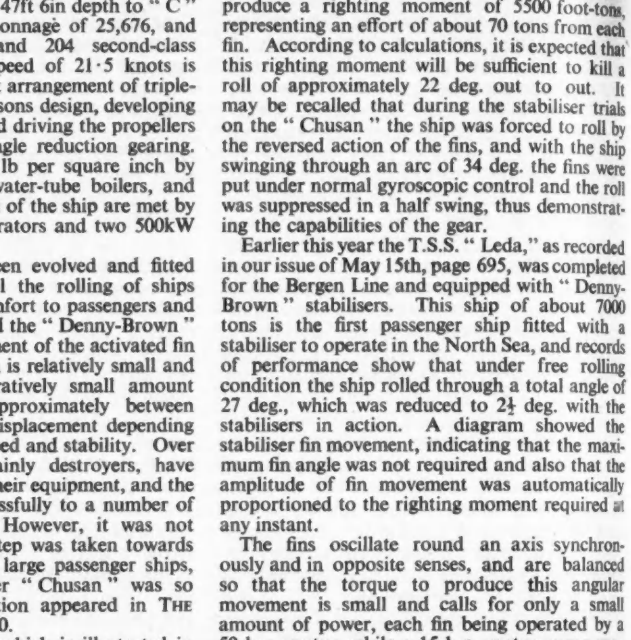
The stabilising system, which is illustrated in our photographs, consists of two rectangular fins, each having an outreach of 12ft, a chord of 6ft 6in, and representing an area of 78 square feet, set transversely in the ship at an angle from the horizontal of about 15 deg. A compartment about five frame spaces in length has been cut off from a refrigerated hold to house the gear, and the fins project from the hull at the turn of bilge at a position forward of 'midships and almost directly under the bridge. It is anticipated that when the ship is moving at her service speed of 21·5 knots the stabilisers will produce a righting moment of 5500 foot-tons, representing an effort of about 70 tons from each fin. According to calculations, it is expected that this righting moment will be sufficient to kill a roll of approximately 22 deg. out to out. It may be recalled that during the stabiliser trials on the " Chusan " the ship was forced to roll by the reversed action of the fins, and with the ship swinging through an arc of 34 deg. the fins were put under normal gyroscopic control and the roll was suppressed in a half swing, thus demonstrating the capabilities of the gear.

Earlier this year the T.S.S. " Leda," as recorded in our issue of May 15th, page 695, was completed for the Bergen Line and equipped with " Denny-Brown " stabilisers. This ship of about 7000 tons is the first passenger ship fitted with a stabiliser to operate in the North Sea, and records of performance show that under free rolling condition the ship rolled through a total angle of 27 deg., which was reduced to 2½ deg. with the stabilisers in action. A diagram showed the stabiliser fin movement, indicating that the maximum fin angle was not required and also that the amplitude of fin movement was automatically proportioned to the righting moment required at any instant.

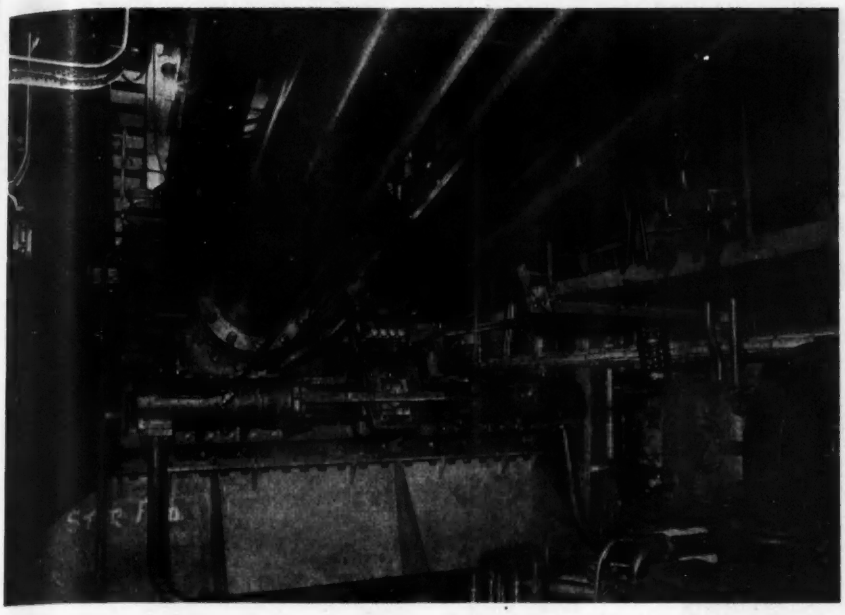
The fins oscillate round an axis synchronously and in opposite senses, and are balanced so that the torque to produce this angular movement is small and calls for only a small amount of power, each fin being operated by a 50 h.p. motor, while a 15 h.p. motor pump provides the power needed for extension and retraction. Rapid oscillation of the fins is achieved by two electrically driven variable delivery pumps, which provide the fluid for



Fin Extended and Angled



Fin Retracted



Stabiliser Compartment

operating the oscillator rams, and the pumps are controlled by the precession effort of two small gyroscopes. The " vertical keeping " gyro comes into action when the ship lists, to angle the fins, and the " velocity " gyro sets the angle of the fins to resist movement from the vertical when a certain angular velocity is exceeded during the rolling of the ship. The overall control is effected from a small cabinet, installed in the bridge. The captain signals for the motors to be started, after which he switches on " Extend Fins " ; then electrical connection is made with the control gyros and the gear automatically operates to damp out the roll of the ship.

Harland and Wolff, Ltd., the company which built the " Andes " in 1939, installed the gear in the ship in carefully planned stages so that the sailing schedule was not interrupted. The total weight of the equipment, including spare gear, is approximately 100 tons. In addition there is necessarily a small loss of buoyancy. It amounts to some 23 tons. This loss of buoyancy is, of course, due to the formation of fin box recesses in the hull for housing the fins when retracted.

Ice-Cream Manufacture

A RECENT visit to the Acton works of T. Wall and Sons, Ltd., gave us an opportunity of seeing the processing involved in the quantity production of ice-cream, some aspects of which the company claims to be in advance of conventional practice. This company has also now commissioned a new cold store, said to be the largest in England, which has a capacity of 1000 tons of ice-cream. The Acton factory is the largest of three which the company has devoted to ice-cream manufacture, and it has a maximum output of about 500,000 gallons per week.

The principal ingredients—sugar, milk powder and vegetable fats, the syrup being discharged directly to storage vats—are transferred to a mixing room and there blended with water in 300-gallon stainless steel tanks. From here the reconstituted cream " mix " then passes through stainless steel pipes to aluminium pasteurising vessels (Fig. 3), each of 500 gallons capacity, in which it is heated to a temperature of 155 deg. Fah. and maintained at that temperature for 30 minutes. This condition is carefully maintained and controlled, the vessels being heated by hot water sprays to avoid local heating.

The mix then proceeds to homogenising plant, passing through gauze filters which retain any suspended solids. Each homogeniser has a capacity of 1000 gallons per hour and its function is to emulsify the fat and distribute the globules uniformly, the mixture being forced through a fine aperture under a pressure of 2000 lb per square inch.

Its preparation complete, the first stages of freezing the mix consist of preliminary cooling in a Mojonnier cooler, shown in Fig. 2. Each cooler is of 1000 gallons capacity and consists of eight leaves over which the mix cascades, water being passed through an upper circuit and ammonia through a lower circuit in the leaves. During its short contact with the leaves the temperature of the mix is reduced from 155 deg. Fah. to 38 deg. Fah.

From here the mix flows to storage tanks, one battery being shown in Fig. 4, the largest holding 4500 gallons. Some are of aluminium and others are glass-lined and in them the mix is allowed to mature for several hours before passing to continuous freezing and aeration machines, from which it is extruded in a plastic state into appropriate containers or delivered to the briquette machines. These continuous freezing machines embody two pumps. The first takes the mix from the hopper, fed directly from the mix storage tanks, and supplies it to a second-stage pump, in the suction side of which is an adjustable air-intake valve. This second-stage pump runs much faster than the first, with the result that it takes up not only the mix supplied by the first pump but also a regulated amount of air. It forces the aerated mix into the barrel of the freezer, to be whipped into a finely-textured whipped cream and frozen. Whipping is carried out by means of a mutator shaft rotating at 600 r.p.m., on which are mounted two scrapers. Liquid ammonia surrounds the mutator barrel and its evaporation under controlled pressure is arranged so that the mix is frozen into a stiff plastic cream. Aeration considerably influences the softness of its texture. It also increases the volume of the ice-cream, this increase being termed " over-run." Samples of ice-cream are constantly checked for the degree of over-run by means of over-run meters and scales.

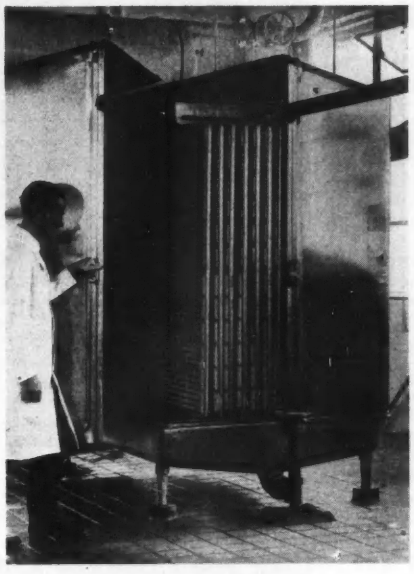


Fig. 2—Mojonnier Cooler

Ice-cream that is to be sold in briquette form is produced by a machine, the " Stonestreet Tunnel," patented by the company and claimed to be in advance of conventional equipment (Fig. 5). The machine is a continuous briquette-producing unit capable of producing 180 briqu-

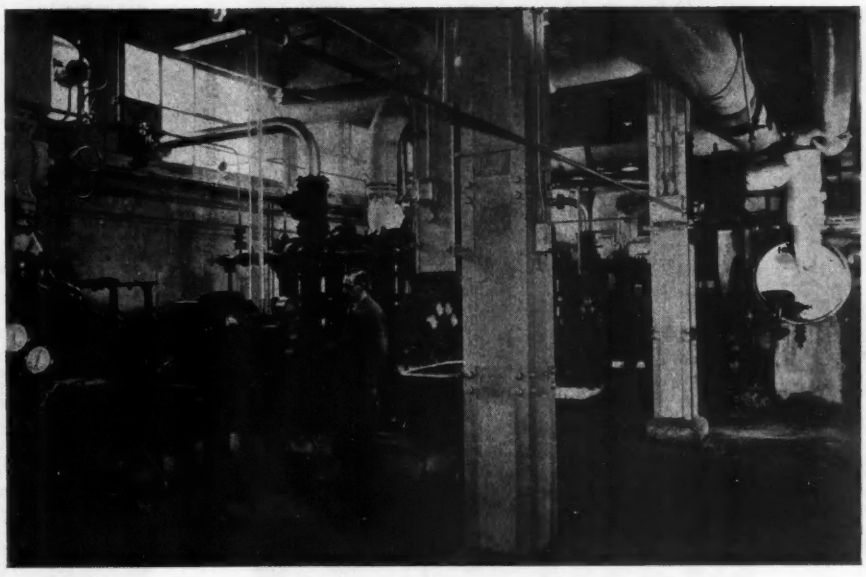


Fig. 1—Compressor Room

ICE-CREAM MANUFACTURE

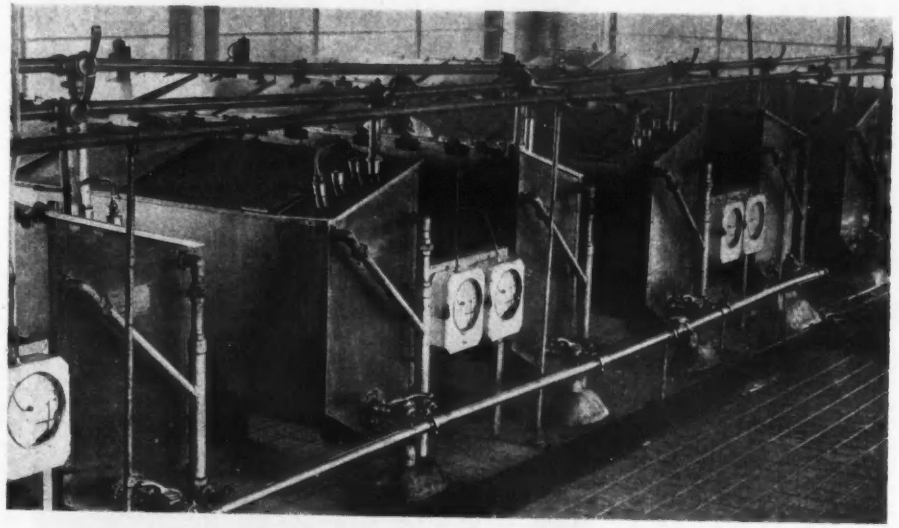


Fig. 3—Pasteurising Plant

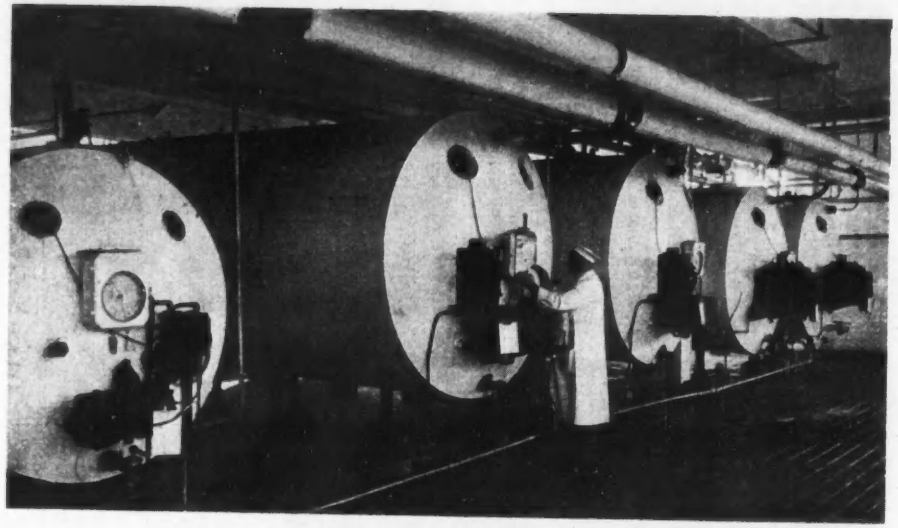


Fig. 4—Ageing Vats

Fig. 5—Briquette Room

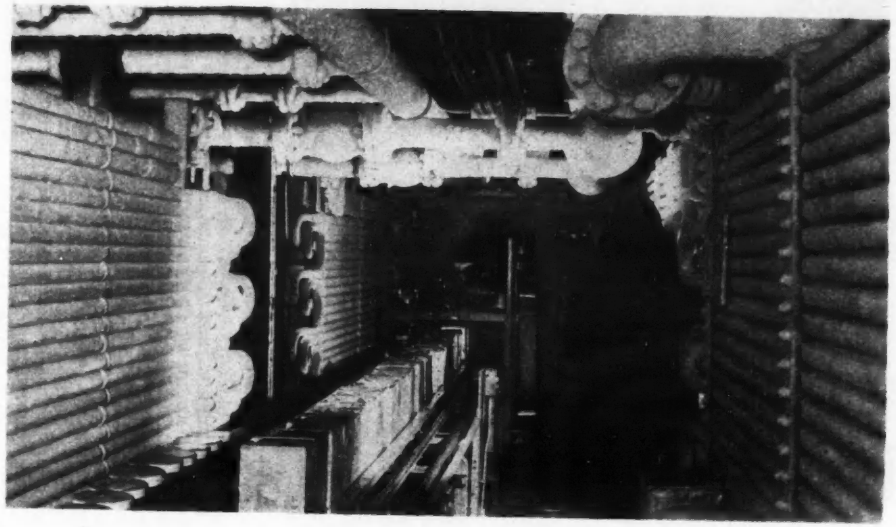


Fig. 6—Interior of Cold Store

ettes per minute. The plastic ice-cream is extruded from a moving head and sliced into briquettes by a rotating wire cutter. The briquettes are delivered on to a moving belt in rows of twenty-two and carried into a blast-hardening tunnel, maintained at minus 25 deg. Fah. As the briquettes freeze rock-hard, they stick to the belt so that when they reach the back of the tunnel and the belt turns over they adhere to it and return on the underside to the front of the tunnel. Here they are stripped off on to a moving, rubberised belt, which carries them to the wrapping machines.

These "Stonestreet Tunnels," of which there are twelve at the Acton factory, are also capable of producing two-flavour briquettes, both flavours being piped to a divided extruder head simultaneously.

The wrapping machines to which the briquettes are carried from the tunnel are mainly Rose wrappers, capable of keeping up to the output of the tunnel.

The Cold Store

The three-storey steel frame cold store has been built on stilts to prevent "frost heave." If such a cold store were built directly on the ground the cold would eventually penetrate the insulation and form ice in the earth itself, which, in time, would lift the building and damage the foundations.

The average temperature of the cold store is minus 15 deg. Fah. A system of moisture extraction is being developed in order to reduce frost deposition. Moreover, all air which, despite air-locks, escapes from the cold store when goods are dispatched, is automatically replaced by dry air, which has been passed over a cooler.

On completion of the building, four weeks were allowed for bringing the temperature down to minus 15 deg. Fah.

In the dispatch yard, to which power-driven conveyor belts bring out the ice-cream for loading into waiting vans, there is a small cabin from which conveyor belts are electrically controlled. By means of a microphone and loud-speakers, the controller can give orders to, or receive messages from, staff in every part of the store. Microphones at strategic points enable the porters to call up the controller immediately to warn him of any hold-up or notify him when they are ready to send down ice-cream to the dispatch yard. Similarly, the loading staff on each floor can control the movement of their own section of the conveyor systems. Conveyors link the three production plants at the works to the cold store. Six powered, wooden-slat conveyors take the various ice-cream products into the cold store. Chain link conveyors are used on the three floors and, altogether, there is more than half-a-mile of conveyor throughout the cold store. On each floor two cold store porters are responsible for unloading the ice-cream off the conveyor and storing it in refrigerated bays (Fig. 6)—most bays being 95ft long. These men wear corduroy tunnel suits, duffle coats and hoods, gloves and knee-boots. All the conveyors converge in an air lock before finally leaving the cold store and trundling the cans out into the dispatch yard.

Refrigeration.—In order to make working conditions as comfortable as possible, it was decided not to use "air-blast cooling," but to cool by liquid ammonia circulating in pipe coils. The actual surface of all the pipe coil amounts to nearly 2 acres—equivalent to a distance of more than 25 miles—and the amount of liquid ammonia flowing in them to nearly 25 tons. The ammonia is circulated by three pumps, each capable of delivering 5000 gallons of liquid ammonia per hour.

After use this ammonia is "collected" in heavy vessels ready for recirculating. These vessels have a capacity of about 130 cubic feet. The refrigeration circuit is completed by two large Lightfoot compressors. The compressors (Fig. 1) have a capacity such that over 700 tons of water could be frozen into ice daily.

Solid CO_2 Plant.—The source of carbon dioxide is flue gas obtained by burning special foundry coke in large boilers. The steam raised in these boilers is used for driving machinery and for heating purposes. The flue gases are washed and are then passed successively through five 90ft absorption towers on the site. In them the gases are washed, this time with "Lye," a strong solution of potassium carbonate, which has the property of absorbing the carbon dioxide gas when cool and of giving it up again when boiled. Boiling takes place in the "Lye" boiler or evaporator and the CO_2 gas released is dried and compressed in stages to a pressure of 1200 lb per square inch. At this pressure, with subsequent cooling, the gas liquefies. In order to transform it into the solid state, liquid CO_2 is squirted into insulated "snow" towers and converted from flake formation into blocks by hydraulic presses situated under the snow towers. It has a temperature in this state of minus 109 deg. Fah.

Cleansing.—When production is over for the day the entire ice-cream plant is thoroughly cleaned, washed with detergents and sterilised. Freezers are dismantled, pumps stripped, pipelines taken down, and blank ends and connections removed by the cleaning staff. Wrapping machines, churns, &c., all receive similar attention before the plant is reassembled for the next shift.

Testing House of the Electrical Development Association

THE Electrical Development Association's new testing house at Leatherhead, Surrey, was formally opened by the president of the Association, Sir Henry Self, on Monday, October 5th. The new premises take the place of the original testing house which was set up in London in 1947 to issue test reports on apparatus submitted to the advisory committee on electrical appliances and accessories. It may be recalled that this committee was set up jointly by the British Electrical Development Association, representing the electricity supply authorities in all parts of Great Britain, and the British Standards Institution, representing all sections of the electrical industry and the users of electrical appliances. The main function of the committee is to adjudicate on the safety of appliances and accessories, whether British or foreign, on the basis of tests made in the E.D.A. testing house. Work is also done for the B.S.I./C.S.A. Approvals Agency, whereby electrical appliances can be tested for compliance with Canadian standards without the necessity of sending samples to Canada for testing.

The test house building, illustrated herewith, consists of two wings—a laboratory wing and a stores wing—on the ground floor, and offices, photographic and X-ray rooms on the first floor. In the laboratory wing on the ground floor there are four main rooms—a laboratory for large apparatus, another for portable apparatus, as illustrated overleaf, a life test room and a controlled humidity and temperature chamber. There is also a laboratory workshop in this wing of the ground floor.

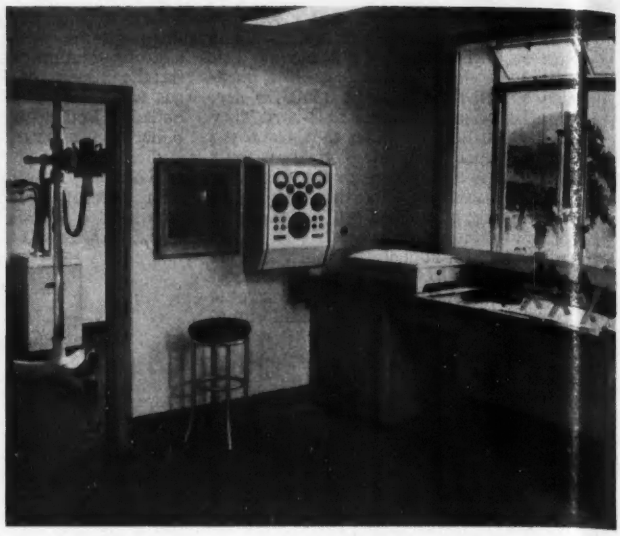
To give the maximum working area in the large apparatus room benches are dispensed with, except along one wall, and electricity supplies are brought down to two panels suspended from the ceiling just above head level, leaving the floor clear of obstruction. More than a quarter of the floor space is quarry-tiled, and this area is bounded by an open trough drain covered by metal grating so that the tiled space can be devoted to apparatus using water. Any steam produced from apparatus tested in this area is removed by an extraction fan in the ceiling. A similar fan on the opposite side of the laboratory provides for the removal of smells from cooking appliances.

Tests under controlled conditions of temperature and humidity can be carried out in a specially equipped room which is directly accessible from the large apparatus room. Here the temperature and humidity are controlled by the circulation of air which is conditioned in the adjoining plant room. The air is extracted through ducts just above floor level, is passed through the conditioning plant and is then returned to the room through the plenum ceiling. Control is maintained through a wet and dry bulb recording controller which is mounted outside the room on the laboratory wall, the sensitive elements being installed in the return air duct in the plant room. Any required temperature between 50 deg. and 90 deg. Fah. and any humidity between 50 per cent and 90 per cent can be maintained in the room. The required values can, it is stated, be maintained to within ± 1 deg. Fah. and ± 2 per cent relative humidity, respectively, even when a domestic clothes drying cabinet is operating in the room.

Among the tests that can be done in the large apparatus laboratory are the determination of water temperature in a thermal storage electric water heater, the measurement of earth leakage

Electrical Development Association's Testing House

Portable Apparatus Laboratory



X-Ray and Photographic Room

current, the determination of thermostat characteristics in accordance with B.S. 1555 : 1949, the measurement of oven temperature, and cooking tests in accordance with B.S. 1315, Part I : 1946.

Adjoining the large apparatus laboratory is a room equipped for radio interference suppression tests. The walls of this room contain a continuous copper mesh screen which excludes external interference and thereby ensures the accuracy of measurements made on appliances under test. The mesh passes across the windows and through the doors and is continuous behind the wall plaster above the ceiling and below the floor. Mains-borne interference is suppressed in a filter unit at the point where the supplies enter the room.

As shown in one of our illustrations, the portable apparatus laboratory is equipped for bench tests on the smaller electrical appliances. Most of the temperature measurements in this room are made by thermo-couples, the outputs of which are fed into a recording potentiometer. The six channels of this instrument can be connected to any of the working positions in the room.

This laboratory is equipped with a surface temperature table. There are a number of 1in diameter brass discs inset flush with the table surface. Soldered to the bottom of each disc is a thermo-couple and the leads are connected to a selector switch so that when an appliance is placed on the table the hottest point on its base can be determined. Temperature tests can be carried out on the windings of fractional horsepower motors for domestic appliances and motor characteristics can be determined by using an eddy-current-braking method.

Before tests are made on insulation characteristics the smaller appliances are conditioned in a constant humidity cabinet until the absorption of moisture remains constant. There is also a test oven to allow the performance of plastic insulation to be examined at elevated temperatures. The laboratory is equipped with a high voltage test set. For appliances on which the exposed metal is earthed the normal test level is 1000V, r.m.s., but, in certain instances where " double insulation " is used the level is increased to 3500V, r.m.s.

The work of this laboratory also includes the measurement of the strength of mouldings, ageing tests for domestic appliance plugs, the measurement of air flow and blade speed of small fans using a light vane anemometer and a " Stroboflash " equipment. Tests are also carried out on fireguards in accordance with B.S. 1945 : 1953, as laid down in regulations made under the Heating Appliances (Fireguards) Act, 1952.

The life-test room is equipped with a two-bank programme controller operated by a master clock so that appliances can be tested on a time cycle. Any sequence of operations from once every five minutes to once a week can be set up on this controller. The life test equipment includes a heating pad tumbling machine in which the pad is subjected to a crumpling action as severe as any that is likely to be met in service. There is also a blanket folding machine to determine the ability of electric blankets to withstand damage through folding and creasing.

Boiling plates are subjected to life tests (B.S. 744 : 1937) of 750 hours' duration on a duty cycle of two hours on circuit and one hour off. To simulate the effect of thermal shock on boiling plates ½ pint of water is placed in a container which is oscillated or rotated so that the water is continually discharged on the hot surface of the plate. Resistance to mechanical shock is determined by a test in which a steel ball weighing 3½ lb is allowed to fall from a height of 6in on to the surface of the plate.

Life tests are also carried out on kettles, domestic irons and washing machines and on components such as tumbler switches, rotary switches, plugs and sockets.

Our final illustration shows the photographic room and, through the door on the left, part of the X-ray room. The latter room contains an X-ray tube operating at voltages up to 150kV peak. The X-ray tube is mounted in a swivelling head and can be aimed downwards or horizontally. As shown in our photograph, the control panel is wall-mounted outside the X-ray room, while the tube can be viewed through a window.

Space Heating

Most of the heating of the building is derived from heating cables embedded in the floors. These cables consist of a core of heating wire encased in a refractory insulating material, with a tubular copper sheath. The cable is in the form of a grid occupying most of the floor space in each room, the distance between adjacent cable runs being between 3in and 6in. To obtain uniform loading the floor-heating cables are connected in three groups, each group being approximately balanced on the three phases.

The method of heat control is designed to make full use of the thermal storage capacity of the floor, to reduce the maximum demand and to avoid the peak load period. The contactors in the heating circuits are controlled, first by outdoor thermostats and secondly by a two-bank timer. At a predetermined outside temperature the first thermostat operates and the timer causes the three heater banks in rotation to be switched on for half-an-hour and off for one hour ; the heating load, therefore, never exceeds one-third of the maximum. A further fall in outside temperature causes a second outdoor thermostat to operate and pass the control to a second bank of the timer, whereby the heating cycle is altered to one hour on and 30 minutes off. There is an over-riding load levelling control which causes a progressive reduction in load as the test load rises.

However, at night when the maximum demand tariff is inoperative, the timer is cut out so that the full heating load is available. Control is then effected by time switches and thermostats whereby the heating time can be adjusted to suit the outside temperature. Maximum use is made of the thermal storage effect : the heat stored before the working day begins is adjusted according to the weather conditions and the heat load is turned off before the end of the day to avoid the evening peak period.

Design for Production

The British Productivity Council has issued this week the report of a team which visited the U.S.A. early last year to study design for production in the engineering and allied industries. Its terms of reference were, broadly, to investigate how design could be integrated with production to ensure the best utilisation of available materials and standard parts. The team was led by Mr. R. S. Medlock, chief research and development engineer of George Kent, Ltd., and Mr. M. Hartland Thomas, chief industrial officer of the Council of Industrial Design. According to the report, the team made a thorough inquiry into the manufacturing policy of the firms which it visited, and reached the conclusion that policy, in so far as it related to design, was formulated in terms which a designer could appreciate and act upon. The initiative seemed to come from the engineering department and, after consultation with the sales department, decisions governing design were affirmed. The report says that the team found that American manufacturers made a careful assessment of the standard of quality required for a particular product, and produced to that standard, but not beyond it. The team has set out a number of recommendations in its report. Among them is the suggestion that co-ordination between design and manufacturing engineering should begin, at the latest, at the design-draughting stage and should be well sustained right through to the production stage. To this is added the recommendation that the greatest possible emphasis should be laid upon the completion of all preparations before production starts on the factory floor. Another recommendation is that opportunities for more industrial and academic training should be given to methods engineers to equip them for co-ordinating work. The report says, however, that " the improvement resulting from this action must not be impaired by permitting any decrease in the qualifications of design engineers."

Brick Output.—At a recent meeting of the London and South Eastern Regional Board for Industry, it was stated that, during August, brick production totalled 39,741,000. At the end of the month, unsold stocks totalled 1,212,000 bricks.

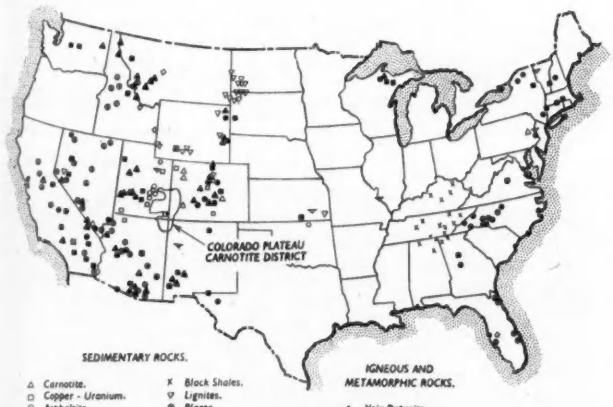
Work of the U.S.A. Atomic Energy Commission

(By Our American Correspondent)

THE fourteenth bi-annual report to Congress of the U.S. Atomic Energy Commission indicates that with regard to the procurement of uranium raw materials, the production of uranium from domestic ores has continued to show substantial gains. Production has already included some by-product uranium from the treatment of phosphate rock at Joliet, Illinois, and additional plants for the by-product recovery of uranium from phosphate rock are nearing completion in Florida and Texas. The Commission has established a small production office at Plant City, Florida, the centre of the Florida phosphate mining industry, because of the increased activity in uranium recovery from phosphates. The construction of a new ore-processing mill by the Anaconda Copper Mining Company, near Grants, New Mexico, is nearing completion and the plant is expected to be in operation shortly. This will bring to nine the number of uranium mills on the Colorado Plateau.

The Colorado Plateau continued to be the centre of the domestic exploration programme of the A.E.C. However, new centres of potential production are becoming increasingly important. An outstanding example is the area in South Dakota and Wyoming surrounding the Black Hills, where a substantial output of ore now is being obtained. The Marysvale, Utah, area continued to be an important producer during the last six months, and minor production was obtained from a number of properties in the Colorado Front Range and the Boulder Batholith region of Montana. Recent discoveries of new ore occurrences in a number of widely separated points in Arizona resulted in increased prospecting and exploration activity in that state, and several of the properties are now producing ore. The accompanying sketch map illustrates the wide distribution of uranium occurrences in the United States and the varied deposits which have been found to be uraniferous. The carnotites, copper-uranium, asphaltite and limestone ores occurring in sediments, and the primary vein deposits have been the only important uranium producers to date, although the A.E.C. and the U.S. Geological Survey have examined every known ore in their search for commercial deposits. The Commission is still actively investigating the potentialities of several of the low-grade sources, such as phosphates, shales, lignites and fluorspars.

Further research is aiming at the development of more efficient and economical processes for the recovery of uranium from its various ores, as well as the recovery of uranium from new ore deposits and the recovery of the small quantities of uranium occurring in low-grade materials, such as phosphates, shales and lignites.



Uranium Deposits in the U.S.A.

Several years of intensive research preceded the initial production of by-product uranium from Florida pebble phosphate, and considerable research and process development still is under way in this field. Phosphate rock is the first American low-grade source of uranium, and efforts are continuing to utilise the uranium present in other low-grade materials. These include additional phosphatic sources such as the phosphoria formations of Montana, Idaho, Wyoming and Utah, and the sub-marginal phosphate beds overlying the commercial phosphate rock in Florida. An investigation of the economic feasibility of extracting uranium from the uraniferous shales of the south-eastern United States has been launched. On January 30, 1953, the Commission announced that a small experimental mine will be operated by the U.S. Bureau of Mines in Tennessee to develop a satisfactory method for mining these shales. The Chattanooga shale is not at present an economic source of uranium, but it is hoped that extraction of the uranium and other components of the shale may become economically feasible.

Production

The production schedules of the A.E.C. for the first six months of 1953 were met, and the amount of fissionable materials produced considerably exceeded that of any previous period. The unit costs of production continued to decline, and now are said to be at the lowest level in the history of the Commission, despite increases in wages and material prices. The increased output is largely due to the completion and successful operation of several new production facilities. A part of the gaseous diffusion facilities at the Paducah works is now in operation. At Hanford, a new reactor and a chemical processing plant have contributed to plutonium production. Some of the supporting facilities at Savannah River are already in operation, preparing materials for the use of the first major production units at that site. The construction of the Feed Materials Production Centre at Fernald, Ohio, was also essentially complete by the end of June. The first electric generator unit at the steam power station of the Tennessee Valley Authority at Shawnee, Kentucky, began commercial operation on April 9, 1953. Test operation of the first unit of the Joppa steam power station of Electric Energy, Incorporated, was resumed late in June after the completion of some design modifications. These two stations are under construction to supply electric power to the gaseous diffusion plants at Paducah, Kentucky.

As at January 1, 1953, the capital investment of the Commission in atomic energy plant facilities was about 4,000,000,000 dollars, which is approximately equal to the total invested in plant and equipment of the United States Steel Corporation, in both cases before depreciation. An additional 3,500,000,000 dollars has been authorised to be used for the construction of new plant facilities. Construction activity for the expansion of atomic energy production facilities continued at a high level during the first half of 1953. During this period the costs incurred for the overall plant and equipment programme averaged about 92,000,000 dollars a month, and accounted for approximately 3 per cent of the total expenditures for new construction in the United States. It is anticipated that monthly costs will increase gradually during the latter half of 1953, reaching a peak of about 130,000,000 dollars per month during the early part of 1954. They will then approximate 5 per cent of the total estimated new construction expenditures in America.

Military Application

A series of eleven nuclear detonations for military test purposes was conducted during March, April, May and June at the Nevada Proving Ground. This was the longest and most complex series yet conducted at the Nevada Proving Ground. The major results of these test operations have been to indicate several very promising approaches to new and improved weapons. The eleventh shot, which was added late in the series, emphasised the value of a test site within the continental United States in that it permitted the shot to be scheduled, fired and the data returned to the laboratory all within the space of one month, thus enhancing the speed of weapon development activities. This added shot obviated the necessity of a full-scale test series which was originally planned for the autumn of 1953. As in the past, the Commission, in conducting the tests, worked closely with the Department of Defence, the Federal Civil Defence Administration, and other Government agencies and private enterprises participating under contract with the various Government agencies. The Commission, through its contractors, was responsible for the test devices and diagnostic measurements, while measurements of effects were performed by the other interested agencies. The Department of Defence again took advantage of several of the detonations for the indoctrination of personnel in the effects of atomic weapons and for simulated combat manœuvres. The Federal Civil Defence Administration subjected two typical American frame dwellings and fifty-one vehicles to the effects of the first detonation in the series. The tenth shot in the series constituted the first firing of a nuclear round from the 280mm cannon of the U.S. Army. To provide flexibility in testing new and improved nuclear weapons, the Commission is enlarging its Pacific Proving Grounds in the Marshall Islands to include the Bikini Atoll, and construction of technical facilities there is under way.

Reactor Development

The period covered by the present report included a greater number of significant events in the field of reactor development than any previous six months in the history of the A.E.C. These events indicated considerable progress in the development of reactors for power generation, nuclear propulsion, and the improved production of fissionable material. The materials testing reactor (M.T.R.), situated at the National Reactor Testing Station in Idaho, was operated on a continuous basis, and provided irradiation facilities for more than 110 tests being performed within the reactor development programme. Much specific information was released concerning the irradiation facilities, power level, neutron fluxes and coolant temperatures of the M.T.R. These data will permit the most effective utilisation of the reactor for the production of special radio-active isotopes for unclassified use, and for the planning of unclassified basic irradiation experiments. The following data appertaining to the M.T.R. have now been released :—

Design power level	30MW
Coolant	Water
Coolant temperatures	100 deg. Fah. inlet, 111 deg. Fah. outlet
Coolant flow rate	20,000 U.S. gallons per minute
Fast neutron flux available for irradiation experiments	1×10^{14} neutrons per square centimetres per second
Maximum thermal neutron flux available for irradiation experiments	4×10^{14} neutrons per square centimetre per second

Laboratory analyses of representative samples from the fuel elements of the core and from the natural uranium blanket that surrounds the core of the experimental breeder reactor (E.B.R.), also situated at the National Reactor Testing Station, have disclosed that the amount of new fissionable material (plutonium) produced in the reactor is at least equal, taking into account chemical separation losses, to the amount of uranium 235 burned during an extended period

of operation. These results confirm the belief in the feasibility of the " breeding " process as originally outlined in 1944. It may be recalled that the only fissionable fuel which occurs in Nature is uranium 235, which constitutes less than 1 per cent of normal, natural uranium. The more common form of the element—uranium 238—may be converted into plutonium in a nuclear reactor. However, until the feasibility of " breeding " was demonstrated in the E.B.R., it was not certain that plutonium could be produced in amounts equal to or greater than the fuel consumed. The significance of the " breeding " process is that in theory all of the world's supply of minable uranium and thorium can be made to undergo fission.

A successful operation of the homogeneous reactor experiment (H.R.E.) at full design power, with the generation of about 150kW of useful electricity, was accomplished on February 24th of this year at the Oak Ridge National Laboratory. This is the second reactor in the United States to generate electricity on an experimental basis. The first electric power from nuclear energy was produced by the E.B.R. in December, 1951. The basic purpose in building the H.R.E. was to determine whether a circulating fuel reactor would operate smoothly. Tests have shown that the reactor operates without large nuclear fluctuations. The H.R.E. represents an approach to nuclear power in which it is hoped that large economies may result from the use of liquid fuel, minimising the costs of fuel fabrication and chemical processing. The experimental operation of the H.R.E. is continuing, with the objectives of solving the many remaining chemical and design problems.

On March 31, 1953, it was announced that the land-based prototype of the submarine thermal reactor (S.T.R.) at the National Reactor Testing Station had achieved " criticality," i.e. that the nuclear components of the reactor had begun to sustain a chain reaction. On May 31st, the reactor first generated substantial amounts of power. Further testing and operation are continuing as the plant gradually is being brought to full power. These experiments will serve to train the crew of the U.S.S. " Nautilus," and to determine the operating characteristics of the submarine power plant, which will be similar to this land-based prototype.

Physical Research

Among the major objectives of the Commission's physical research programme are the improvement of the processes used in present operations and the broadening of the scientific basis for new potentialities in the use of atomic energy. Basic research is financed by the A.E.C. in universities, private research institutions, and in the national laboratories. The national laboratories also carry the major responsibility for solving problems which have an immediate bearing on current operations of the atomic energy programme.

The demand in the field of nuclear energy for new materials with unusual properties has stimulated interest in ceramics. Some ceramic materials, such as graphite, beryllium oxide and Portland cement, are used as moderators or for shielding purposes in many of the nuclear reactors now in operation. Others are useful as containers for processing metals required in the construction and operation of reactors. Ceramics research and development centres have therefore been organised at the Oak Ridge and Argonne National Laboratories. The group at Oak Ridge is studying pure oxides, borides, nitrides, carbides, ceramic-metal combinations (cermets), and other ceramic materials. The Ames Laboratory is specialising in the preparation of crucible materials for the melting and casting of metals. The Argonne National Laboratory and Battelle Memorial Institute are exploring the properties of a number of oxides, nitrides and carbides in combination with various metals as refractory compounds potentially useful in reactor construction.

The application of atomic energy requires the use of unconventional materials at temperatures beyond the range of previous industrial experience. Under such conditions corrosion has become an acute problem. The current physical research programme includes studies of the basic nature and underlying causes of corrosion with the objective of reducing it in specific situations. The Argonne National Laboratory is engaged in basic studies of the corrosion of aluminium, zirconium and uranium alloys in dilute aqueous solutions at various temperatures. Subsequently, other metals of value as reactor components will be investigated. Until recently, zirconium was a little-used and little-known metal, and its properties still are not completely understood. Now that it is coming into extensive use in reactors, fundamental investigations of its corrosion are being made. The Pennsylvania State College is studying the theory of the corrosion of zirconium, with particular emphasis on the effect of impurities and the use of halides as corrosion inhibitors. The Case Institute of Technology is investigating the fundamental nature and cause of the corrosion or scaling of zirconium in air at elevated temperatures. The University of Oregon is conducting a research programme on the electro-chemistry of zirconium and zirconium alloys in different aqueous media.

In any reactor the fission products, or " ashes," ultimately have to be removed to allow the fission process to continue. In pure form these radio-active by-products of the reactor operation are useful sources of radiation. Therefore, chemical processes are required for the separation and purification of the fission products, as well as for the recovery of the unused fissionable material. The Oak Ridge National Laboratory, the Knolls Atomic Power Laboratory, and the Argonne National Laboratory, have been developing such processes, specialising in the fundamentals of ion exchange, solvent extraction and other methods for the separation of these materials. In the more extensive field of separation chemistry, these laboratories are interested not only in improving processes which are in use for operations such as the extraction of plutonium from irradiated fuel, or the recovery of uranium from its ore, but also are looking toward the development of new and more economical processes. For example, Oak Ridge developed the process used in the new chemical plant at the National Reactor Testing Station in Idaho. The Knolls Laboratory, in addition to developing equipment for the Savannah River separations plant, has made extensive pilot plant tests on the complete separations procedure employed. The Argonne National Laboratory developed the separation methods to be used in the recovery of spent fuel for the submarine thermal reactor.

Experiments have yet to show the basic role in the structure of the nucleus played by the newly discovered sub-nuclear particles called mesons. Some of these particles are found in cosmic radiation, and some have been produced from the collisions of high-speed particles from the largest particle accelerators. Most mesons have masses intermediate between the proton and the electron, although some are heavier than the proton. Some are charged positively, some negatively, and some have no charge at all. All those discovered thus far have a short life, after which they transform into other mesons or into the better-known particles, such as protons, electrons or gamma rays. It is clear that these unstable particles must be taken into account in the theory of the nucleus, but first such fundamental properties as their masses, charges and lifetimes must be known. The problem of the nucleus has become more difficult to solve because of the large number of mesons which have been discovered. Apparently the end of such discoveries has not yet been reached. Research in this field is continuing under the sponsorship of the A.E.C. and below are listed certain data relating to the unstable elementary particles which are known at present :

Table of Known Unstable Elementary Particles

Name	Possible decay products	Lifetime (seconds)	Mass (units of electron mass)	Remarks
$V_1^{\pm}$ particle	Proton + π^0	(?)	2200(?)	A few cloud chamber tracks have been observed. The only experimental examples of charged V_1 particles are positive, but the analogous V_1^- may also occur
V_1^0 particle	Proton + π^-	$2{\cdot}5\times10^{-10}$(?)	2190	Existence well established. Has been produced by Cosmotron
Neutron	Proton + electron + neutrino	740	1837	A well-known particle
V_2^0 particle	$\varkappa^+ + \pi^+$ perhaps also $\varkappa^+ + \pi^-$	(?)	(?)	Only a few cloud chamber tracks have been observed
$S^{\pm}$ particle	$\pi^{\pm}$ + (a neutral ?)	10^{-8}–10^{-9}	1480(?)	The existence of these particles seems established, but their masses and lifetimes are uncertain. Collectively these particles are sometimes referred to as K particles
$\chi^{\pm}$ meson	$\pi^{\pm}$ + (a neutral ?)	10^{-8}–10^{-9}	1400(?)	
$V^{\pm}$ meson	$\pi^{\pm}$ or $\mu^{\pm}$	(?)	800–1100	
$\varkappa^{\pm}$ meson	$\mu^{\pm}$ + (2 neutral ?)	(?)	800–1100	
$\tau^{\pm}$ meson	$\pi^{\pm} + \pi^+ + \pi^-$	10^{-8}–10^{-9}	975(?)	Observed as three charged particles which decay from a charged particle
V_2^0 particle	$\pi^+ + \pi^-$	10^{-10}(?)	972(?)	Observed in a cloud chamber as two charged particles which decay from a neutral particle
ζ^0 particle(?)	$\pi^+ + \pi^-$	10^{-14}(?)	556(?)	The evidence for their existence may have other interpretations
$\zeta^{\pm}$ particle(?)	$\pi^{\pm}$ + (π^0 ?)	10^{-11}(?)	552(?)	The evidence for their existence may have other interpretations
$\pi^{\pm}$ meson	$\mu^{\pm}$ + neutrino	$2{\cdot}6\times10^{-8}$	276	Very well established : found in cosmic rays and produced artificially by high energy accelerators
π^0 meson	2γ	5×10^{-15}(?)	266	Well established : found in cosmic rays and produced artificially by high energy accelerators
$\mu^{\pm}$ meson	Electron + 2 neutrinos Positron + 2 neutrinos	$2{\cdot}15\times10^{-6}$	212	Decay product of π meson. Well established

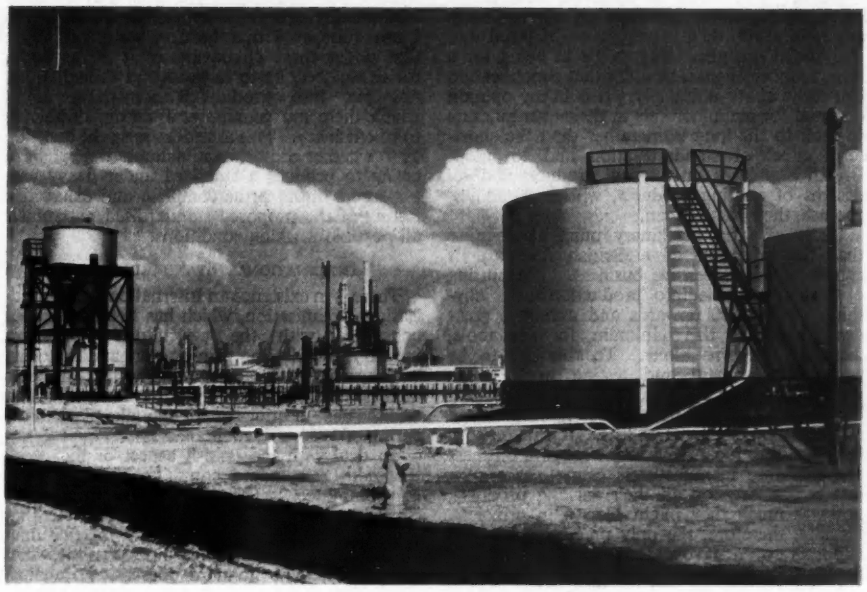
Only those particles about which there is some agreement are listed in this table. Some of the entries in the table are likely to be changed as further information is accumulated.

During the past six months plans were made for additional shielding to be placed around some of the existing high-energy accelerators, a new linear accelerator neared completion, and plans were made to purchase an additional Van de Graaff accelerator. Studies of the radiation intensities around the synchro-cyclotron at the Carnegie Institute of Technology have indicated that additional shielding will be required as a result of improvements now being made in the oscillator. These changes are planned to increase the proton beam current by a factor of about 10. The machine accelerates particles to an energy of 420MeV. Additional shielding also will be required for the synchro-cyclotron at the University of Rochester. The building which will house the linear electron accelerator at Yale University is nearly completed. The construction and installation of the accelerator and the associated neutron cross-section-measurement equipment will be completed in the autumn of 1953. This 20MeV machine will be used as a high-resolution, time-of-flight velocity selector for neutron cross-section measurements.

The alternating gradient principle for focusing charged particles has been tested experimentally by the A.E.C. at the University of California Radiation Laboratory and at Oak Ridge, and independently in Niels Bohr's Laboratory in Denmark. Scientists at the Radiation Laboratory have focused the beam of the 40ft linear proton accelerator, which resulted in a considerable increase in the output current density. It is believed that the application of the alternating gradient focusing principle, which results in the confining of charged particles to a beam of unusually small cross section, may make possible

the construction of very high-energy accelerators at lower cost. The higher energies available with such machines not only will allow investigators to probe still deeper into the nature of matter, but also may result in practical applications in such fields as radiography and radiation therapy.

The heavy-particle cyclotron at the Oak Ridge National Laboratory is now being used to accelerate large currents of triply charged nitrogen ions. The nuclei of nine light elements between hydrogen and sulphur were bombarded with the 25MeV nitrogen ions produced in this 63in cyclotron. More than twenty new nuclear reactions have been observed and their average cross sections determined. Many of these are new kinds of reactions, previously unreported, including reactions in which nitrogen nuclei combine with nuclei of such elements as carbon, oxygen and sulphur to produce the much heavier nuclei of sodium, aluminium and scandium. A very large ion current for cyclotrons was achieved with the 86in cyclotron at the Oak Ridge National Laboratory. A proton current of 3 milli-amperes at 22MeV was obtained, with an overall electrical efficiency of 19 per cent. Several new isotopes have been discovered with this machine, and the radio-active isotopes of gallium, potassium, dysprosium, erbium and thulium have been definitely identified. In a study of nuclear structure and nuclear diffraction effects, measurements have been made of the angular distributions of 22MeV protons elastically scattered by fifteen different elements from beryllium to thorium.



Oil Refinery near Antwerp

Continental Engineering News

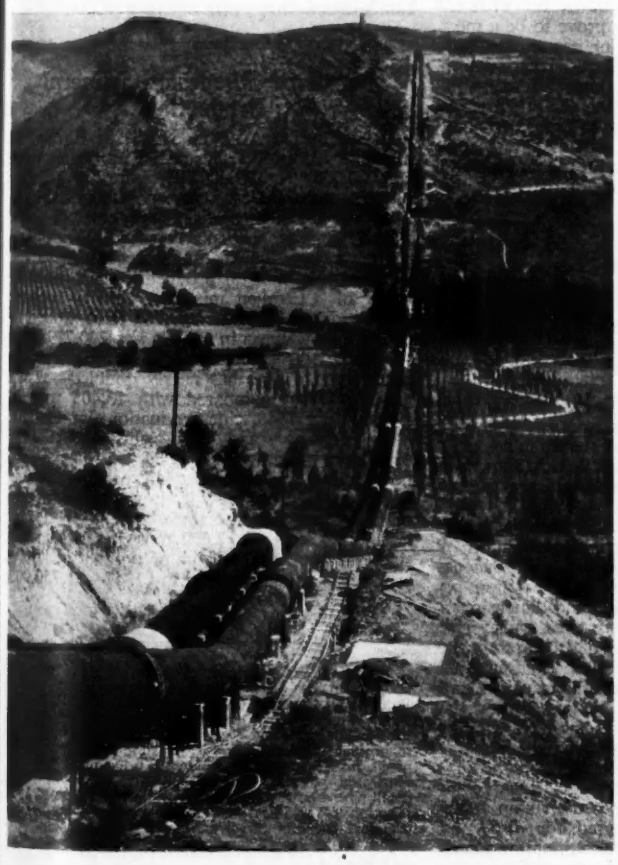
(By Our Continental Correspondent)

The New Esso Refinery, Antwerp, Belgium

The new Antwerp oil refinery, belonging to the Esso Company, was officially opened by the Prime Minister of Belgium on September 8th. The new refinery, occupying a 190-acre site along the Schelde River, is designed for a crude oil capacity of 25,000 barrels per day. The refinery, illustrated above, took two years to build and cost about £9,000,000.

The Schinznach-Bad Bridge

A notable steel bridge was recently erected over the River Aar, near Schinznach-Bad, Switzerland. The bridge was built by Messrs. Watrmann and Co. It is a plate girder structure with curved soffit. There are three spans of 112ft, 158ft and 112ft, respectively. The decking accommodates a 19½ft roadway, a 6½ft sidewalk and a 2½ft path. The steel superstructure was assembled by electric arc welding. The weight of the bridge amounts to about 170 tons. The new bridge forms a part of the Wildegg-Brugg hydro-electric scheme; it rests on the piers of the old bridge, which were suitably strengthened.



San Vicente Pipeline

The San Vicente Pipeline, Spain

To meet the water requirements of the Spanish capital, the authorities concerned built about a century ago a canal, called the Canal Isabelle II, after the Queen of Spain reigning at that time. Since then the population of Madrid has grown from 200,000 to some 1,700,000. The canal is served by three reservoirs. Three aqueducts lead water from these storage reservoirs to six underground tanks, having an overall capacity of 1,300,000 cubic yards. One of these aqueducts spans the San Vicente ravine by means of a siphon, consisting of a steel pipe, 4½ft in diameter. In 1948 it was decided to lay a second pipe, also 4½ft in diameter, alongside the first, with an overall length of 4200ft. The work, illustrated here, being done by the Omes Company, is now being completed. The pipe sections rest on concrete supports, spaced at 10ft to 13ft centres. The pipeline was fabricated by arc welding.

Standardisation and Agricultural Machinery

On Tuesday last, Mr. D. P. Ransome delivered his presidential address to the Institution of British Agricultural Engineers. The first part of the address surveyed the organisation of the British Standards Institution, and the value of standardisation to industry in general. The following portions of the address deal more specifically with standardisation in relation to agricultural machinery.*

NATIONAL standards are nothing new to agricultural engineers and the agricultural machinery industry, but in recent years, following on what is known as the Lemon Report on the agricultural machinery industry, it has been felt that there was a need for a greater amount of standardisation in those parts of machines known as wearing parts, and, with the introduction of the three-point tractor mounting, a standard or standards to ensure the interchangeability of implements of different makes on tractors of different makes, in other words a standard for three-point linkages. When the Agricultural Machinery and Implements Standards Committee was in due course formed at the invitation of the British Standards Institution, it decided there was a need for other standards as well, such as for tractor tests and a glossary to standardise the names by which various implements and machines and parts of these should be known.

In most cases manufacturers are already working to the British Standards which have been issued, or plan to introduce them at the first appropriate opportunity, but farmers in general complain that they have not seen any benefit. That is not, perhaps, very surprising once one appreciates what is involved for a manufacturer to change over to a British Standard. No user is every likely to see an immediate and quick benefit after the introduction of a British Standard for parts or components.

I know of many cases where a manufacturer supplies more spare parts for machines no longer in production than he makes of similar parts for new machines plus spares for those machines. Therefore, if he changed over his current machines to comply with a British Standard, the supply of spares for existing machines would heavily outweigh the supply of standard parts for a great number of years. Quite obviously the adoption of a standard involves manufacturers in producing yet another

* Managing director, E. H. Bentall and Co., Ltd.

type, or more likely a complete new range. Nevertheless, if standardisation is to mean anything at all, then it has got to be faced that this added complication may be in being for a large number of years in order that simplification can come about ultimately. It is in my opinion essential for manufacturers in their own interests to look to the long term rather than the short-term effect of standardisation and to adopt British Standards on all new products and re-designs of existing products, whenever, and as soon as, they possibly can.

Users of farm machinery must also realise that the adoption of a British Standard is usually a very expensive business. The putting of a new machine into production costs anything from £1000 upwards and usually a great deal more than this minimum, for jigs, tools, dies, and patterns alone. To this has to be added development and testing work which may be involved even to incorporate a British Standard, possibly new sales literature and certainly new spare parts lists. It can be seen therefore that it can be a very expensive business and therefore manufacturers cannot, as a rule, just switch over on all their existing products, however much they might like to in principle. Usually, therefore, the only practical course to adopt is to endeavour to bring in the British Standard on new machines or those having to be redesigned in any case. As an illustration of what the introduction of a British Standard may involve, and one which is going to affect farmers before long and possibly is already doing so, might be cited the recently issued British Standards for unified screw threads, bolts, nuts and washers, B.S. 1580, B.S. 1769 and B.S. 1768.

As most members will know, these have been brought about at the request of the Defence Departments of the U.S.A., Canada and Britain in order to simplify joint armament production and maintenance, particularly in time of war. Broadly, these new British Standards, which also become Canadian and American Standards, mean that our well-known Whitworth and British Standard fine threads and sizes will, and in fact are, being superseded by American threads and bolt and nut sizes. This relatively simple change will cost British industry several million pounds in new dies, tools, jigs, and machine tools, and will cause users and manufacturers of engineering products nightmare problems in regard to spanner sizes, taps and dies for many years, not to mention spare parts lists problems. In the end, perhaps twenty years' time, American, Canadian and British machines will all have common sizes of bolts, nuts and screws to the undoubted advantage of all concerned, but in the meantime there will be another cause for our farmers to complain that spanners won't fit nuts and screws won't fit tapped holes, which will be a repetition of the same trouble experienced during and since the war. All the manufacturer can do is to try and make the changeover as orderly as possible.

There appears to be an idea amongst both farmers and some manufacturers that if a British Standard is issued it has to be adopted. This is not so. A manufacturer is completely free to adopt it or not as he thinks fit, and therefore the issue of a British Standard does not, except in rare cases, cause any brake upon new design and development. Furthermore, British Standards are constantly under review, so that if there is a change in need or general practice the British Standard is revised to bring it into line with the modern requirement. On the other hand, as manufacturers must have themselves both agreed to the desirability for a standard and themselves have produced that standard, a Gilbertian situation arises if they then refuse to adopt it. There may, of course, be very good reasons for this happening, but in our industry, out of the standards already issued and those nearing the issuing stage, there appears to be only one case where this may possibly happen. That is in the case of mower fingers, and even in this case it is only part of a British Standard since this remark does not apply to knife sections and rivets. A mower finger, although simple in appearance, is very tricky in its design. A standardised finger is in effect a compromise, which may or may not be satisfactory when fitted to any particular make of cutter bar and used under various conditions. It is early to say that manufacturers will not adopt the British Standard finger, but after trial by some manufacturers it does appear to be doubtful. I am quite sure that farmers would all agree that under these circumstances it is far better for manufacturers to have second thoughts and not put into production something about which there are genuine and sincere doubts as to its efficiency. This case does raise the question as to whether or not manufacturers were right in trying to produce a standard under heavy user pressure without prior complete and exhaustive testing of the proposed standardised part under all possible working conditions.

International Standardisation

There is in existence an International Standardisation Organisation, which has two committees concerned with the agricultural machinery industry, one dealing with tractors and the other with agricultural machinery. The first meetings of these committees took place in Paris last year, and the next meetings are due to take place in the spring of 1954 at Lisbon.

To deal with the British aspect of this work the industry standard committee has a special sub-committee. The main concern of this committee is to ensure so far as possible that British Standards are adopted as International Standards and, if this is not possible, that the International Standard does not go against the British Standard, that is to say that if something complies with the British Standard it will at the same time come within the International Standard. A tremendous amount of time is spent by the representatives of manufacturers and others on this work, and as a result of these labours it is gratifying that no International Standard so far envisaged goes against British Standards, and to a very large extent British Standards specifications are being incorporated.

From these remarks it will be obvious how important it is for British Standards to keep ahead of standards issued by foreign countries, because experience has so far proved that when a British Standard is in existence there is a much greater possibility of the British viewpoint giving a lead to the international discussion. Britain to-day leads the world in agricultural machinery national standardisation, and this fact is undoubtedly assisting in the field of international standards, and may prove to be a most important factor in promoting economical production and export of British agricultural machinery in the years to come. I make no apology, therefore, for drawing the attention of our manufacturer members to this aspect of standardisation, for unless manufacturers continue to play their part fully in the preparation and adoption of British Standards, and thereby the international standards, we could find ourselves faced with international standards being adopted in very many countries which might not either agree with our own designs of products or, worse still, call for designs of machines which are fundamentally different from those produced in this country. That manufacturers do in general appreciate these facts is indicated by the success which has been achieved by the British delegation on the international committees in preventing such happenings as these. The existence of British Standards and the work being done in this country by the technical committees prior to the issue of British Standards have contributed in no small measure to this success.

At the present time the International Committees are working on the standardisation of tractor details, such as P.T.O. shaft dimensions, speed, direction of rotation and position on the tractor ; drawbar position and dimensions ; mounting of implements, tyre sizes, pulley size and clearances ; and position of driving controls. They are also working on an international glossary of terms for agricultural machines and parts, and this is likely to be based upon the British glossary, which at this moment is being amended before publication to make the numbering system accord with the classification and subdivisions acceptable to the international committee. Germany has proposed that an International Standard be prepared for discs and Britain has proposed that international standards be considered for knife sections and fingers for mowers, lengths of cutter bars for mowers, and spray nozzles. All these latter items are already being worked upon and it will be noted that the first two of the items are already covered by British Standards, the second is obviously tied to an existing British Standard and the last is on the list of work to be dealt with by a technical committee with a view to a British Standard being drawn up. This programme of work, in fact, practically the whole of the work being tackled by I.S.O., clearly indicates the advantage to be obtained by the British in leading in the field of standardisation.

Probably nothing can be more controversial than the subject of standardisation when it comes down to the detail specification, and probably in no industry is there more reason for controversy than in the agricultural machinery industry, and this arises out of the fact that agricultural machines have to cater for a greater variety of conditions in use than probably any other kind of machinery. I have referred earlier to the question of the mower finger, and I think this is a very good example of the difficulties involved. Quite apart from the question of expense and other commercial considerations, it is not just a case of a finger being able to be bolted on to any cutter bar. There are other factors in the design which, in combination with each other, give a good finger that will ensure good cutting under various conditions. Vary one of these factors and the finger is unsatisfactory. We are here talking about very small differences, perhaps one or two degrees at the most in the downward angle of the knife sections, perhaps a small fraction of an inch on some dimensions. The difference between a manufacturer's existing finger and a British Standard one might be just one or two such small variations in dimension, and it appears to be unfortunately true that as a result, what may now be a perfectly sound finger becomes a bad one on that particular maker's machine. It is things like this which cause manufacturers to hesitate in a case of this nature, and that is why I feel that there should be patience and tolerance on the part of users of agricultural machines in this matter of standardisation, bearing in mind that the manufacturers have amply demonstrated their good will to seek national standardisation, where standardisation is possible and desirable.

Northern Rhodesian Mineral Production

In the past ten years Northern Rhodesia's mineral production has risen in value from £13,000,000 to £79,000,000, but this has not been accompanied by a corresponding expansion in tonnages ; higher prices have been the main cause. This is particularly so in the case of blister copper, which contributes more to the value of total mineral production than the total value of all other minerals. Blister copper production in 1943 was 189,760 tons, valued at £8,500,000, whereas in 1952 it was 200,799 tons, valued at nearly £46,000,000. In ten years the production of zinc has nearly doubled—22,890 tons last year, compared with 13,405 tons in 1943. Since 1948, zinc production figures have been fairly constant. The value of the 1952 production—almost £4,000,000, was 36 per cent below that of 1951, although production was slightly up. The 1947 lead production figure of 15,640 tons has not since been attained, and last year's total of 12,600 tons was the lowest since that year. The value of production, however, was higher than in 1947—£1,750,000 against £1,250,000.

Power Transmission by Chain.—A new technical publication has been published for engineers by the Renold and Coventry Chain Company, Ltd., 28, Deansgate, Manchester, 3, entitled "Renold Power Transmission Diagrams and Technique." The book is designed to provide in a compact form a simple explanation of precision chain driving technique. Opening with an illustrated glossary of terms, it then deals in some detail with a large number of drive layouts followed by a selection of technical and miscellaneous data on the principal aspects of chain power transmission. A useful chain length and centre distance nomogram accompanies the book and there is also a set of scale tracings to assist draughtsmen when it is required to show chains on drawings.

Industrial and Labour Notes

Engineering Wages

On Wednesday of last week, there was a meeting in London of representatives of the Engineering and Allied Employers' National Federation and the Confederation of Shipbuilding and Engineering Unions, at which the employers gave their reply to the union's claim for a 15 per cent increase on the consolidated time rates of adult male workers in the engineering industry. The claim, which was formulated and submitted in July by the Confederation of Shipbuilding and Engineering Unions, was first suggested in May last by the national committee of the Amalgamated Engineering Union. It was based on increased productivity in the industry, the high level of profits, and the increased cost of living.

At last week's meeting the claim was rejected by the employers. Their reply was made by Mr. B. Macarty, director of the Engineering and Allied Employers' National Federation, who said that it was not true, as the unions claimed, that earnings in the engineering industry had not kept pace with the rise in the cost of living. In January, 1948, the retail price index stood at 104, and by July, 1953, had reached 141, an increase of 35·6 per cent. In the same period the average weekly earnings of adult male workers in the engineering industry rose by 48 per cent for timeworkers and 47 per cent for payment by results workers. Since the date of consideration of last year's wage claim the price index had risen another six points, or 4·4 per cent, but the average weekly earnings of adult male workers showed an increase of over 6·4 per cent. The last wage increase had given an extra 2d. an hour, and since then earnings had further increased and brought that figure up to 3d. an hour. Mr. Macarty went on to say that higher output in the engineering industry had been due largely to improved techniques and new and more efficient machines, but for some time output had been in excess of incoming orders. Over the year ended May last there had been a reduction in the volume of orders of 25 per cent, and that had followed a decline of 8 per cent in the preceding year. Export figures alone showed a drop of 20 per cent, following a decline of 12½ per cent the preceding year.

Mr. Macarty then pointed out that the days were over when prices once tendered could be altered to meet increases in wages and in the cost of raw materials. Contract prices, he said, must now be firm. Nor could wage increases be met out of profits. A large proportion of profits must be ploughed back into the industry to keep it efficient, and the profits earned were showing a downward trend. In the majority of cases the engineering industry did not put up prices to cover the last wage increases and many prices had to be reduced to secure business and to meet growing foreign competition. This, Mr. Macarty emphasised, could not happen again, and any advance in wages now would compel a general increase in prices and would impair the industry's ability even to maintain its exports, at a time when the national need was for greater exports. Sir Percy Mills, president of the Employers' Federation, who also spoke, said that the present wage claim had been made at a time when prices were no longer generally increasing, but when it was obvious that the time had come when some effort should be made to try and achieve stability.

The rejection of the claim was discussed at a meeting in York on Thursday of last week of the executive of the Confederation of Shipbuilding and Engineering Unions. After the meeting it was stated that a further approach to the employers would be made.

Employment and Unemployment

The latest monthly report by the Ministry of Labour on the employment situation in Great Britain says that, at the end of August the total working population was 23,473,000 (15,918,000 men and 7,555,000 women). That total was 121,000 higher than the figure for July, the main contributory factor being the number of school-leavers taken into employment.

The number of people in civil employment at the end of August was 22,320,000 (14,890,000 men and 7,430,000 women), which was 106,000 more than a month previously. Of the total, 4,091,000 were at work in the basic industries, the principal increase in the group being a seasonal addition of 15,000 to the number employed in agriculture. In the coal mining industry there was a decline of 2000, the number of wage-earners on colliery books being 716,000 at the end of August, compared with 720,000 at the end of last year. In the manufacturing industries there was a net addition of 67,000, bringing the total employed to 8,799,000, compared with 8,683,000 at the end of last year. In the manufacturing group classified by the Ministry of Labour as "engineering, metal goods and precision instruments," there was an increase during August of 17,000 in the number employed, bringing the total to 2,537,000, which, however, was still 21,000 below the end-1952 figure. In vehicle manufacturing there was an addition of 10,000 to the labour force in August, making the total number employed 1,131,000, compared with 1,112,000 at the end of last year.

The unemployment figures included in the Ministry's report relate to September 14th, on which date 291,970 people were registered as out of work, compared with 293,536 on August 10th. It is also stated that, in the week ended August 29th, about 30,000 operatives in manufacturing establishments rendering returns were reported to be on short time, losing 11½ hours each on the average; on the other hand, 1,324,000 were working, on an average, eight hours' overtime.

Iron and Steel Foundries Regulations

In these notes in our issue of December 19, 1952, reference was made to a Private Members' Bill entitled the Foundry Workers (Health and Safety) Bill, which was given a second reading in the House of Commons on December 12, 1952, and which was subsequently withdrawn. Following discussions with representatives of industrial organisations interested in the contents of the Bill, the Minister of Labour decided to initiate the statutory procedure for making special regulations under the Factories Acts.

Draft regulations were published last January and objections to them were later discussed between representatives of the Ministry and of the organisations representing the employers and workers concerned. The amended regulations, entitled the Iron and Steel Foundries Regulations, 1953, have now been published. They contain requirements as to gangways, suppression of dust and fumes, protective equipment, bathing facilities, clothing accommodation, and the arrangement and storage of foundry equipment and tools. These regulations will come into operation on January 1, 1954, with the exception of the requirements relating to the suppression of dust and fumes, bathing facilities and clothing accommodation, which will take effect on January 1, 1956.

British Trade Fair in Baghdad

In a speech at Nottingham last week, Sir Norman Kipping, Director-General of the Federation of British Industries, announced that the United Kingdom Government and the Government of Iraq had given their blessing to a proposal of the F.B.I. to organise a British trade fair in Baghdad in the autumn of 1954. Sir Norman said that big developments were now taking place in Iraq as a result of the agreement between the Iraq Government and the oil companies, which would increase Iraq's budget by between £40,000,000 and £50,000,000 a year. Whilst the greater part of that money would go towards financing large capital projects such as dams, hydro-electric installations, bridges and roads, considerable sums would also go into consumer spending.

The main purpose of the British trade fair, Sir Norman explained, would be to show what British industry had to offer the peoples of Iraq and other Middle Eastern countries; not only equipment for the capital development projects now in hand or being planned, but also consumer goods. It would also have the secondary object of demonstrating, possibly by models, how those development projects worked and how, even though they took time, they would greatly increase the real wealth of the country. The fair, Sir Norman added, would be open to the public as well as to trade buyers. A preliminary survey had already been carried out, as a result of which it had been decided to stage the fair towards the end of October or early in November, 1954.

Steel Production

The production of steel ingots and castings averaged 346,500 tons a week during September, and was thus at an annual output rate of 18,019,000 tons, a higher figure than in any September previously. Last year, steel output in September was at an annual rate of 17,149,000 tons. During the third quarter of the current year, despite the effect of holidays, steel production was at an annual rate of 16,019,000 tons, compared with a rate of 15,224,000 tons in the corresponding quarter of last year. In giving these figures, the British Iron and Steel Federation has stated that over the first nine months of this year steel production has averaged 334,400 tons a week, which is more than 10 per cent above the average for the comparable period of 1952. Pig iron production in September averaged 213,900 tons a week, which represented an annual rate of 11,123,000 tons, compared with a rate of 10,845,000 tons in September last year.

Overseas Trade

The Board of Trade has estimated provisionally that exports of United Kingdom goods in September were valued at £201,800,000, a figure £14,000,000 below the average for the two preceding months, July and August. The monthly average value of exports in the third quarter of this year, however, at £211,400,000, was slightly above the average of the second quarter. In the third quarter, there were five more working days than in the second quarter, but the effect of annual holidays in industry must be taken into account. The value of imports in September has been estimated at £269,700,000, which was about the same as the figure for the two preceding months. The value of imports over the whole of the third quarter has averaged £275,700,000 a month, which was 5 per cent lower than the average of the second quarter. Re-exports in September totalled £7,900,000, so that the excess of imports over total exports was £60,000,000. In the third quarter, the excess averaged £55,900,000 a month, which, the Board of Trade says, was well below the level of the second quarter.

The Employment of Older People

This week there has been published the first report of a committee, which was set up by the Minister of Labour in March, 1952, to "advise and assist in promoting the employment of older men and women." The aim of this committee is to suggest the general lines on which the Government, public and private bodies may work together to enable and encourage men and women in all kinds of employment—in industry, commerce and the professions—to use their skills and experience to a greater age, with benefit both to their own well-being and to the national economy.

In this first report, the committee has set out some considerations which it thinks employers, workers and the public in general should be encouraged to examine. The committee says that it is convinced that the principal barrier to the extended employment of older persons lies in traditional attitudes of mind and that only a better understanding of the issues is likely to change them. The report urges that employing authorities of all kinds should adopt a positive policy to give older people a fair chance on their merits to compete for available jobs. Any practices or agreements, provisions attached to pension schemes, or other special arrangements which place an age barrier in the way of older people seeking employment, should be reviewed. The test for engagement, the committee thinks, should be capacity, and not age.

Notes and Memoranda

Rail and Road

IMPROVEMENT ON THE NORTH LONDON ELECTRIC LINE.—It is announced that work is to begin shortly on the modernisation of Willesden (High Level) Station on the Broad Street to Richmond electric line. This scheme will cost some £49,000 and involves the removal of the present buildings and their replacement by more modern structures and the transfer of the booking hall and booking offices to a more convenient site.

WATERFOG EQUIPMENT ON ESCALATORS.—The considerable quantity of dirt and fluff which collects underneath escalators on the London Transport underground system not only impedes maintenance work but also presents a definite fire risk, and to reduce this risk many escalators have been fitted with waterfog equipment. This equipment consists of a series of pressure nozzles arranged in pairs at regular intervals below the moving stair treads. These nozzles are fed from the main water supply at a minimum pressure of 50 lb per square inch, and when turned on emit a very fine mist which reaches every part of the machine beneath the treads. Should smouldering occur the water supply can be turned on by any available member of the staff and the smouldering damped out before any serious damage to the escalator is caused. The equipment is also used for the routine removal of dirt and fluff.

BITUMINOUS ROAD MATERIALS.—The Road Research Laboratory has issued a technical paper (No. 27) which surveys asphalt and coated macadam plants. The report shows that with modern road-laying machinery it is often necessary to get the maximum possible output from an asphalt plant. In some cases an increase in the output of up to 50 per cent might be achieved, with little or no increase in the size of the plant, by making improvements in the heating and screening arrangements and in some aspects of the general design. The survey was made in close co-operation with the firms working the plants, while they were engaged in normal commercial production. In the manufacture of bituminous road materials, the product must comply with the specification and be uniform in quality. At the same time, the output of the mixing plant must keep pace both with the supply of material and with the capability of the laying machines. The survey was made to find out in what ways the operation of each plant fell short of this idea and to show where improvements were most needed. One recommendation made as a result of the survey is that on asphalt plants, a separate feed-hopper with controlled output should be provided for each size of aggregate to eliminate delays due to empty or overfull hot-storage bins. Asphalt plants using two storage bins for hot aggregate generally gave as satisfactory control of grading as those using four bins. It is suggested also that automatic methods of proportioning the materials should be adopted on batch plants for both aggregate and binder. They appear to be quicker than visual methods, and are more reliable and accurate. Improvements are urgently needed in the arrangements for handling and proportioning filler on both batch and continuous plants. The report is available at H.M. Stationery Office, price 2s.

Air and Water

REFINERY JETTY.—An ocean tanker jetty to accommodate vessels of 16,000 tons has been built in the Brentella Canal near the oil dock at the Porto Marghera refinery, Venice, and two existing jetties are to be modified to allow larger vessels to berth.

MR. T. F. CROSSLING.—We have learned with regret of the death of Mr. T. F. Crossling, the naval architect of the Shaw, Savill and Albion Company, Ltd. Mr. Crossling, who joined the company in 1911, was appointed assistant to the marine superintendent in 1935 and was made naval architect in 1952.

CLOSED FEED SYSTEMS.—We have received from G. and J. Weir, Ltd., Glasgow, a copy of a new booklet entitled "The Weir Closed Feed System." The booklet generally discusses the system and summarises its advantages and then goes on to describe the general scheme of the Weir closed feed system, aided by photographs and a number of diagrammatic illustrations. Individual items of systems are dealt with and a series of working instructions are noted.

MARINE FANS.—A brochure with the title "Aerofoil Marine Fans" has been published recently by Woods of Colchester, Ltd., and deals generally with the development of this design of fan. Graphs give some idea of the performance of two fans and there is special mention of single stage and dual duty fans followed by notes dealing with fan casings and motors. A section discusses control panels and sound levels while a table gives typical duties of aerofoil fans and this is followed by a series of data sheets which list the dimensions and weights of various designs of fans over a range of sizes.

INSTITUTE OF NAVIGATION.—The seventh annual general meeting of the Institute of Navigation was held in London on Wednesday last, October 14th, when the election of Mr. D. H. Sadler, superintendent of H.M. Nautical Almanac Office, as president for 1953–54 was confirmed. The annual report of the council states that the membership of the Institute is now 1349. The report also gives some particulars about the progress of special investigations undertaken by working parties of the Institute's technical committee. These include a study of methods of flight-planning to determine the least-time route on long distance flights; an investigation into the accuracy of astronomical observations at sea, a study of radar plotting at sea, and a study of the requirements for civil air maps and charts.

SHIPBUILDING CONFERENCE.—At the annual general meeting of the Shipbuilding Conference, held in London on October 7th, Mr. J. W. Elliot, C.B.E., chairman of Swan, Hunter and Wigham Richardson, Ltd., and of the Wallsend Slipway and Engineering Company, Ltd., was elected president in succession to Mr. Charles Connell, M.A. Dr. James M. McNeill, C.B.E., F.R.S., the deputy chairman and managing director of John Brown and Co. (Clydebank), Ltd., was elected vice-president.

THE INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—At the general meeting of the Institution of Engineers and Shipbuilders in Scotland the following awards were made for papers read during the 1952–53 session:—Mr. D. S. Gordon, B.Sc., received the Institution Medal for his paper "Instruments and Techniques in Vibration Research"; and the W. W. Marriner Premium was given to Mr. A. R. Mitchell, for his paper "Tunnel Type Vessels." Institution Premiums were awarded to Mr. C. Garside for his paper "Inspection Problems in the Manufacture of Modern Jet Engines," and to Mr. T. W. Bunyan, B.Sc., and Mr. H. H. Attia, M.Sc., Ph.D., for their paper "Investigation of the Effect of Fillet Radii on the Torsional Fatigue Strength of Marine Shafting."

Miscellanea

KENT OIL REFINERY.—At the Kent Oil Refinery of the Anglo-Iranian Oil Company, Ltd., on the Isle of Grain, the catalytic cracking plant has been completed and will be put into commission shortly.

MR. TOM MILNER.—We record with regret the death of Mr. Tom Milner, works and production director of Richard Sutcliffe, Ltd., Horbury, Wakefield, which occurred on October 6th. Mr. Milner, who was sixty-six, joined the firm in 1906.

OIL SEARCH.—The test well being drilled by the D'Arcy Exploration Company at Plungar, a few miles east of Nottingham, has produced a small quantity of oil, and drilling, which has reached a depth of 2899ft, is continuing in search of a lower stratum of oil-bearing rock.

JUNIOR INSTITUTION OF ENGINEERS.—Sir John Hacking has accepted an invitation to become president of the Junior Institution of Engineers for 1953–54. He will take office at a meeting of the Institution to be held on Friday, December 11th, at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2.

CORRECTION.—In the article dealing with the Engineering, Marine and Welding Exhibition which appeared in our issue of October 2nd, the illustrations referring to Figs. 36 and 38 were transposed, the Rolls-Royce engine being shown in Fig. 38 instead of Fig. 36, which is, of course, the Mirrlees, Bickerton and Day engine.

EXPORT SALES CONFERENCE.—The Federation of British Industries is arranging an export sales conference, which will be held at Buxton on Friday and Saturday, October 30th and 31st. Opening addresses will be given by Sir Harry Pilkington, president of the F.B.I., and Sir William Rootes, chairman of the Dollar Exports Council, following which there are to be group discussions dealing with discovery of export opportunity, organisation for exports, relations between exporter and importer, the export sales force, and the creation of opportunity.

MANGANESE IN THE IRON AND STEEL INDUSTRY.—The iron and steel committee of the Organisation for European Economic Co-operation has prepared a booklet dealing with the use of manganese in the iron and steel industry. The contents of the booklet are based on information which has been supplied by member-countries. This information has emphasised that the supply of manganese continues to cause concern in Western Europe, and the aim of the committee responsible for the preparation of the booklet has been to indicate methods for the more economical use of manganese.

A DEMONSTRATION OF MACHINE TOOLS.—A demonstration of modern machine tools and equipment to be given by Alfred Herbert, Ltd., at its London showrooms, 70, Vauxhall Bridge Road, S.W.1, from October 26th to November 3rd next, is designed to be of particular interest to firms producing small parts for the watch, clock and instrument industries, and general production work on automatics and capstans. The demonstrations will include high-speed bar work on automatics and capstans; chuck work on the Herbert "Auto Junior"; milling on an Archdale 20in horizontal machine; centreless grinding on a Scrivener No. 1; grinding and lapping of carbide and high-speed tools on a Thielicke machine; and inspection work on Sigma machines.

MODEL TESTS IN SOIL MECHANICS.—We have received, from the Laboratorio Nacional de Engenharia Civil, Av. do Brasil, Lisbon, Portugal, two technical reports, published in English, which are entitled "Similarity Conditions in Model Studies of Soil Mechanics Problems" and "Some Results of Settlement Observations in Actual Structures and in Models." Both of these reports are concerned with the correlation of model experiments with the behaviour of the full-scale prototypes in certain soil mechanics problems. In the case of the second report, observations on the actual settlement of four structures are compared with the theoretical predictions deduced from load tests on the soils concerned. The Laboratory has also sent us a third report, published in Portuguese, which reviews various soil mechanics problems emphasised by the Ninth International Road Congress, which was held in Lisbon in 1951.

QUARRYING IN THE MALVERN HILLS.—The Minister of Housing and Local Government, has issued his decisions on four applications for planning permission to continue the winning and working of igneous rock from four quarries established in the Malvern Hills. All the applications have been the subject of local inquiries. The quarries concerned are Tank Quarry, North Quarry, Earnslow Quarry and Gullet Quarry. At North Quarry planning permission has been refused, but the company will be free to continue the working of stone to stabilise a landslip in accordance with an earlier decision of the Minister. In the three other applications a limited permission has been given. In a letter commenting on the decisions which he has sent to all the interested parties, the Minister says that the result of these decisions must be progressively to reduce the output of stone from the Malvern Hills and eventually to stop it altogether.

TECHNICAL PUBLICATION ON PETROLEUM.—The Esso Petroleum Company, Ltd., has recently published a technical booklet entitled "Proving Ground," which discusses a large number of fundamentals related to petroleum and oils such as specific gravity, flash point, colour, viscosity and then goes on to consider cloud and pour points, dilution of crankcase oils, saponification and steam emulsion numbers. Other subjects generally reviewed include ash content, carbon residue, dielectric strength, corrosion and the oxidation of lubricating oils, while there are notes upon octane and octane numbers, aniline point, distillation and the thermal value of fuel oils. The analysis and testing of grease, the penetration of greases and the melting point of petroleum waxes form the subject of other sections contained in the booklet, which concludes with an extensive glossary of terms generally associated with he petroleum industry.

MATERIALS HANDLING.—The importance of materials handling in connection with manufacturing industries has engaged the attention of the Institution of Production Engineers for some time, and in order that the fullest information might be made available, the research committee of the Institution appointed a special sub-committee in 1951 to investigate and report on British materials handling practice. The results of this investigation have now been published under the title "A Review of Materials Handling in British Manufacturing Industries." The review surveys present materials handling practice in industry, sets out fundamental factors which govern the introduction of improved methods into factories, reports on materials handling and industrial safety, outlines training schemes for materials handling, and concludes with a series of recommendations. Copies of the review, priced 5s. net, can be obtained from the Institution offices 36, Portman Square, London, W.1.

Personal and Business

MR. J. M. DOUGLAS has been appointed managing director of the Argus Foundry, Ltd., Thornliebank.

MR. CHRISTOPHER WILSON has been appointed assistant to the general manager of the Machine Tool Trades Association.

E. C. MUSSETT AND CO., Ltd., has moved its works from St. George's Way, Peckham, London, S.E.15, to new premises at Rye Harbour, Sussex.

MR. L. P. PARKER, Wh.Ex., M.I.C.E., is retiring on October 21st from the position of motive power superintendent, Eastern Region of British Railways.

MR. C. D. MORGAN has been appointed secretary of the British Road Federation. He has been secretary to the Institute of Road Transport Engineers since 1947.

MR. A. W. WADE has resigned his position as export manager of Blaw Knox, Ltd., to become general manager of Con-Mech (Engineers), Ltd., 4, Southampton Place, London, W.C.1.

G.P.U., Ltd., states that Mr. G. L. R. Jones, its technical director, is now in charge of the new advisory technical office for industry and trade at Lloyd House, 44, Bryanston Street, London, W.1 (telephone, Paddington 4077).

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., announces the retirement of Mr. P. H. Harding, head of the tender engineering department at the Willesden works. Mr. Harding has completed fifty years in the company's service. His successor at the Willesden works is Mr. G. E. G. Foden, A.M.I.E.E.

BABCOCK AND WILCOX, Ltd., states that Mr. I. M. Lyon is to retire at the end of the year from his post as general manager of the Renfrew and Dumbarton works. He will continue to serve as a consultant. Mr. D. D. Cruickshank is to succeed Mr. Lyon as general manager of the Renfrew and Dumbarton works and Mr. T. Carlile has been appointed assistant general manager.

THE BRUSH GROUP states that Mr. C. F. Barnard, general manager of Mirrlees, Bickerton and Day, Ltd., Stockport, has been appointed managing director of that company. Mr. I. B. Cooke, formerly works manager of Fielding and Platt, Ltd., Gloucester, has been appointed a director and general manager of the Hopkinson Electric Company, Ltd., Cardiff. Mr. J. W. C. Milligan is relinquishing his position as managing director of Hopkinson Electric Company, Ltd., but retains a seat on the board.

British Patent Specifications

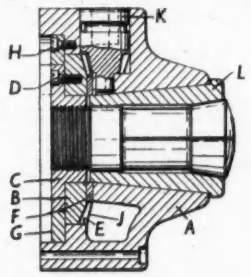
When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application: the second date, at the end of the abridgment, is the date of publication of the complete specification.

Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2 2s. 8d. each.

WORKSHOP TOOLS AND APPLIANCES

696,485. June 1, 1950.—COLLET CHUCKS, Raymond Jack Baker, 10, Norman Avenue, East Twickenham, Middlesex.

The chuck shown in the drawing comprises a cylindrical body *A* mounted on the usual form of chuck backplate and is held by fixing screws passed through the screw holes, or directly attached to a spindle nose. The rear face of the chuck body is recessed for an operating ring *B* provided at its centre with a renewable threaded bush *C* fixed in position by screws *D*; the thread in the bush being suited for the collets in use. The ring *B* and the bush *C* can be formed in one piece. The bush is flanged at



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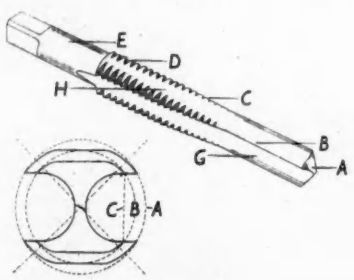
the inner periphery and is accommodated in a correspondingly shaped bore of the ring. The ring rotates within a bore *E* of the body and its forward face bears against ring *F* resting on a radial bearing face of the body. It is retained axially by means of a keeper ring *G* at the periphery secured against a radial wall of the chuck body by screws *H*. The forward outer edge of the operating ring *B* is provided with bevel teeth *J* in driving engagement with bushes *K* rotatably mounted in spaced radial bores in the body, radial movement being prevented by pins in the body in engagement with grooves in the bushes. The chuck body is provided with a main axial bore to co-operate with the collets, through the intermediary of a sleeve *L*. In operation a collet is inserted in the coned sleeve *L* and the operating ring *B* and bush *C* are rotated by means of the chuck key so that the bush draws the collet to the work-gripping position. Modified designs for lever operation and auxiliary devices are also shown in the specification.—*September* 2, 1953.

696,833. November 17, 1950.—ENGINEERS' TAPS AND DRILLS, Reginald Bastien, 35, Ferrers Avenue, West Drayton, Middlesex.

The invention concerns engineers' taps and taps and drills combined in one tool. Its object is to simplify the operation of forming threads to eliminate breakage of taps, to avoid the spoiling of work, to reduce the manual or machine effort and the number of operations involved. The tool comprises a straight drill portion *A* with four "lands" *B*, followed by a tapered tap portion *C*, a full-thread tap portion *D* and a shank *E*. Two straight flutes *G* extend from the drill-point to beyond the tap



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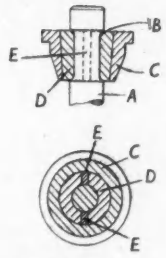
portion. The flutes decrease in depth gradually and their position may be varied and set off-centre as necessary, further to improve the cutting angles. The central relief *H* of the tap portion extends also to cover the full length of the drill portion and is merged at each edge of the drill into the true tapping size diameter. The end view shows respectively the outside diameter of the threaded tap portion, the core diameter of the threaded portion, and the width of flute which is equal to half of the outside diameter. For example, if the outside diameter is 1in, the width of flute will be ¼in. The co-arrangement of flutes and relief gives four "lands" to the drill portion and four points of contact to the tap portion. If normal coneccentric relief were incorporated on the tap, the number of points of contact would be halved and therefore the central relief particularly described for the combined tap and drill as also for a separate tap is preferable in use, as the trailing edge scavenges the thread-swarf when reversing out from the workpiece.—*September* 9, 1953.

INTERNAL COMBUSTION ENGINES

696,778. February 27, 1951.—POPPET VALVES, Valves, Ltd., Parkside, Coventry. (*Inventor: Walter Joseph Elliott.*)

The object of the invention is to enable the oil-sealing of the split cotter of a poppet valve to be effected in a simple and convenient manner. In the drawings one end only of the poppet valve stem is shown at *A*. On this stem is formed a circumferential groove *B*, and around the groove is mounted the annular support *C* for the valve spring. The support is secured to the stem by a tapered two-part cotter *D*. There is bonded to the longitudinal edges of one or each cotter parts a sealing strip *E* made from synthetic rubber or other oil resistant material. By sealing the longitudinal edges of the cotter parts in the manner described, the leakage of lubricating oil past the cotter is prevented. Modified arrangements of valve stems and sealing strips are shown in the specification.—*September* 9, 1953.



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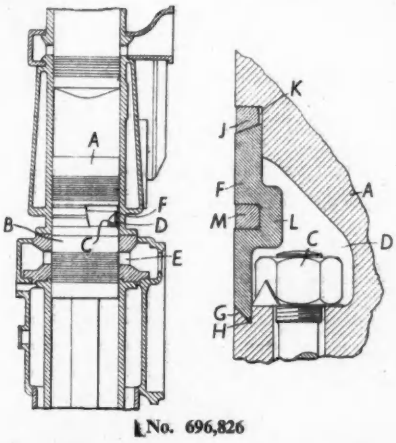
696,826. September 15, 1950.—DIESEL ENGINES, The M.E.P. Company, Ltd., Derby Square, Castle Street, Liverpool. (*Inventor: Charles Guthrie Guthrie.*)

This invention particularly relates to double-acting, two-cycle diesel engines. Its objects are to counteract the tendency of certain types of diesel engines catching fire, such fires starting generally in the scavenge belt or scavenge port zone of the engine and to promote improved lubrication of the cylinder walls. Referring to the left-hand drawing, one known form of double-acting two stroke diesel engine of the type with which the invention is particularly concerned is shown. The main piston comprises two elements *A* and *B* which are bolted together, the nuts *C* of the bolts being housed in an annular groove or grooves or pockets *D* in the piston body. *E* indicates the scavenge ports of the engine and it will be appreciated that each time the groove or pockets *D* pass the scavenge ports they will receive a puff of air which may make any burnt oil or carbon in the groove or pockets incandescent. Should any



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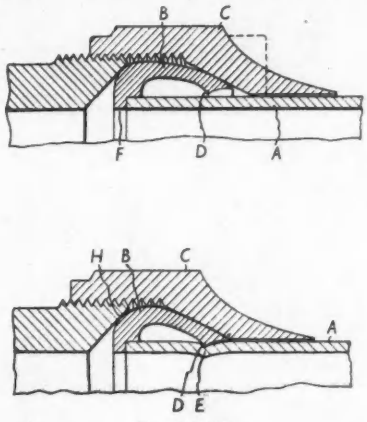
of these incandescent particles find their way through the scavenge ports *E* they may well start a fire in the scavenge belt and this may spread to the whole engine. To prevent this the piston is provided as shown in the right-hand drawing, with a shroud, cover or anti-fire ring *F*. This ring is in two semi-cylindrical parts and one edge *G* is bevelled and fits into an under-cut groove *H* in the piston body. After the parts of the anti-fire ring have been assembled the ring is secured in position by an inwardly sprung ring *J* located in a small annular space *K* between the upper edge of the ring and the annular recess in the piston. The ring may be thickened circumferentially as indicated at *L* and recessed to receive a further ring *M* for keeping the parts of the ring together. The outer surface of the anti-fire ring is substantially flush with the surface of the piston and forms a closed space to which no burnt lubricating oil or carbon can gain access. A modified arrangement is also shown in the specification.—*September* 9, 1953.

TUBE AND PIPE CONNECTIONS

696,999. June 5, 1952.—CONNECTIONS FOR RIGID TUBES, Aeroquip Corporation, 300, South East Avenue, Jackson, Michigan, U.S.A. (*Inventor: Roger Roland LaMarre.*)

Referring to the drawings, *A* indicates a rigid tube and *B* a deformable sleeve which can be slid over one end of the tube and be deformed by the



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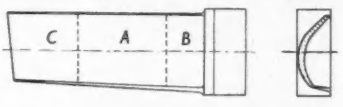
action of tightening a union nut *C*, to cause an annular knife edge *D* to bite into the tube surface as indicated at *E* in the lower view. The sleeve *B* has its knife edge *D* at the end remote from an in-turned flange which abuts against the end edge of the tube *A*. On its outer surface the sleeve *B* is rounded, as shown, and presents a sealing contact *H* to the tapered surface of a connecting nipple. The general construction of the nipple and the union nut is clearly shown in the drawings.—*September* 9, 1953.

GAS TURBINES

696,715. June 15, 1951.—BLADES FOR GAS TURBINES, Metro-Cutanit, Ltd., Grappenhall, near Warrington, Lancashire.

The invention relates to the construction of turbine blades having a high resistivity to heat and scale formation, especially for gas turbines, from a compound material formed from high melting point hard material consisting of one or more carbides, borides or silicides, and an alloy resistant to scale formation. The blade proper is subdivided into three zones, *A*, *B* and *C*. For zone *A* a composition may be chosen containing 30 per cent titanium carbide as the high-melting-point hard material and 70 per cent of a 20 per cent nickel-chromium alloy as the scale resistant alloy. The zone *B* may contain 50 per cent titanium carbide and the zone *C* 70 per cent titanium carbide, while the rest in each case is formed by the 20 per cent nickel-chromium alloy. From the processed powders provided for the separate zones a suitable stratified



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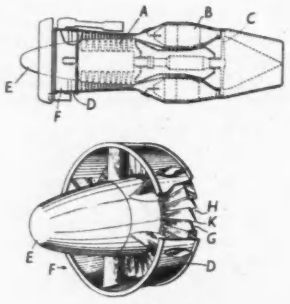
body is pressed and presintered at a comparatively low temperature of 800 deg. to 1000 deg. Cent. The presintered body may still be readily machined at this stage and is accordingly given its final form before being finally sintered at a higher temperature 1300 deg. to 1800 deg. Cent. It is expedient to use for the final sintering a furnace in which there is a heat gradient so that it is possible for the zones richest in hard materials to be sintered at a higher temperature. In the example given it has proved expedient to choose for the zone *A* consisting of 70 per cent of the 20 per cent nickel-chromium alloy a sintering temperature of 1350 deg. Cent., a temperature which lies just below the melting point of the nickel-chromium alloy. But for the zone *C*, which has a titanium-carbide content of 70 per cent, a higher sintering temperature of about 1550 deg. Cent. is advantageous. A stratified turbine blade produced in the way described has proved to be very advantageous, having regard to the stresses occurring in gas turbines. The zone *A* has a very high toughness due to its high nickel-chromium alloy content, while the zone *C* which in service is subjected to very high temperatures but to low mechanical stresses, although being rather brittle,

is still sufficiently resistant to heat and to scale formation even at temperatures of 1300 deg. Cent. Two other examples of blade composition are also given in the specification.—*September* 9, 1953.

697,006. May 1, 1950.—WATER SEPARATING GUIDE VANES FOR GAS TURBINES, Winnett Boyd, care of A. V. Roe Canada, Ltd., of Malton, County Peel, Ontario, Canada, and John Lewis Orr, care of the National Research Council, the City of Ottawa, County of Carleton, Ontario, Canada.

An object of the invention is to provide an improved construction for the protection of aircraft gas turbine engine compressors against icing. Refer-



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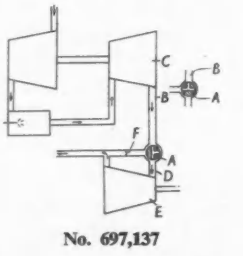
ring to the drawing there is shown a compressor *A*, a combustion system *B* and a turbine *C*. The compressor comprises a multi-stage rotor mounted within a compressor casing *D*, the internal wall of this casing, together with the external surfaces of a nose bullet *E*, defining an annular air intake *F* for the engine. A series of inlet guide vanes *G* is mounted in a circumferential ring around the intake in a plane transverse to the axis of the engine and extending radially across the intake. The guide vanes are spaced to provide passages *H* for the admission of air to the compressor. Each of the guide vanes is of aerofoil section and has a camber greater than in conventional practice; moreover, the number of guide vanes provided in the installation is greater than in conventional practice and the spacing between adjacent guide vanes is such that the leading edge *J* of one guide vane will overlap the trailing edge *K* of the next adjacent guide vane by a predetermined amount. Further details of the blade construction, including heated blades, are also given in the specification.—*September* 16, 1953.

697,137. July 4, 1951.—GAS TURBINE INSTALLATIONS, The Parsons and Marine Engineering Turbine Research and Development Association, Pametrada Research Station, Wallsend-on-Tyne, and Basil Joseph Terrell, 3, Eastfield Avenue, Monkseaton.

The drawing shows an installation having the simple cycle—compressor—combustion chamber—compressor turbine, the three units constituting the gas generator line—separate output turbine discharging to atmosphere. A change-over valve *A* is arranged between the exhaust pipe *B* of the compressor turbine *C* and the inlet *A* of the output turbine *E*. The



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change-over valve also controls the flow of gas to atmosphere through an orifice *F*, the arrangement being such that with the change-over valve in the position shown, the gas passes from the compressor turbine exhaust *B* through the output turbine *E* and then to atmosphere, while in another position (not shown here) the gas passes to atmosphere through the orifice *F*, the orifice being suitably proportioned to produce the same pressure drop as the turbine *E* so that there will then be no disturbance of the working conditions in the gas generator line when the valve is moved from one position to the other. The specification also shows the invention applied to a more complicated installation.. The arrangement provides for extremely rapid manœuvring from zero to full power and vice versa without significant temperature variation in the components when once the plant has been thoroughly heated up.—*September* 16, 1953.

British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 2, Park Street, London, W.1.

COPPER TUBES FOR GENERAL PURPOSES

No. 2017 : 1953. Price 3s. There have previously been published a number of standards for copper tubes for specialised uses, which in most cases include fully dimensioned tables of sizes of tubes to which the standards apply. The need has been felt, however, for a standard for copper tubes which would meet the requirements of general users who find it difficult to select suitable sizes from the dimensional tables in existing standards and who may often prefer to specify copper tubes by the outside diameter required, normally expressed in inches and fractions of an inch, and by the required thickness, normally in imperial standard wire gauge numbers. It is believed that the standard in the form now presented should meet the needs indicated above, including, among others, those of users in the automobile, petroleum and refrigeration industries, from whom requests have previously been received for a new standard to meet their special requirements. In many instances, tubes for general usage are required for connection by fittings involving a close fit between the outside of the tube and the socket of the fitting. It has been considered desirable, therefore, to include two ranges of tolerances on outside diameter. Table II, providing for the usual plus and minus tolerances, and Table III, providing for a limited minus tolerance only, to meet the conditions required for connection by the types of fittings mentioned. It has been found necessary to confine the application of the closer range of tolerances on diameter to a preferred list of sizes from ¼in to 2in outside diameter which is given in Appendix A. With a view to promoting a reduction in the number of sizes demanded, it is hoped that users will endeavour to select their tube sizes up to 2in outside diameter from the list of preferred sizes in Appendix A, irrespective of the range of tolerances on diameter which is required. The standard indicates a preferred method of designating tubes for general purposes which it is hoped will be followed by users wherever practicable. Appendix B gives tables of sizes of copper tubes for general purposes required for screwed connections, taken from B.S. 61, Part 1. Appendix C gives a table of sizes of copper tubes for the petroleum industry. These sizes have been selected from Tables V and VI of B.S. 1306, Part 2, "Seamless Copper Tubes for Steam Services," with the exception of the 2½in size, which is similar to the corresponding size in A.S.T.M. B.42. Additional provisions to meet the special conditions of the refrigeration industry are included separately in Section 2.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

Tues., Oct. 20th.—54, Station Road, New Barnet, Herts, Presidential Address, "Education and Training in the Electrical Industry," C. T. Melling.

BRITISH INSTITUTION OF RADIO ENGINEERS

Wed., Oct. 21st.—LONDON SECTION : London School of Hygiene, Keppel Street, W.C.1, Annual General Meeting, 6 p.m.

CHEMICAL SOCIETY

Fri., Oct. 23rd.—BIRMINGHAM : The University, "Analytical Errors : Heinous and Otherwise," T. B. Smith, 4.30 p.m.——ABERDEEN : Robert Gordon's Technical College, Aberdeen, "Structure Stereochemistry and Inclusion Compounds of Some Phenol Derivatives," W. Baker, 7.30 p.m.——GLASGOW : The Royal Technical College, "Fluorescence of Solutions," E. J. Bowen, 3.30 p.m.
Wed., Oct. 21st.—IRISH REPUBLIC : Chemistry Department, University College, Upper Merrion Street, Dublin, "Phosphates in Biochemical Reactions," A. K. Mills, 7.45 p.m.

INCORPORATED PLANT ENGINEERS

Mon., Oct. 19th.—MERSEYSIDE AND NORTH WALES BRANCH : Radiant House, Bold Street, Liverpool, "Design of a Central Heating System," N. Woodhead, 7.15 p.m.
Tues., Oct. 20th.—SOUTH WALES BRANCH : Mackworth Hotel, Swansea, "Lubrication," talk and films by courtesy of Shell Mex and B.P., Ltd.
Wed., Oct. 21st.—GLASGOW BRANCH : The Scottish Building Centre, 425/427, Sauchiehall Street, "Fire Prevention : Fire-Fighting in Industrial Premises," M. Chadwick, 7 p.m.——KENT BRANCH : The Bull Hotel, Rochester, "Heat Recovery From Oil Engines," N. Halliwell, 7 p.m.——WESTERN BRANCH : The Grand Hotel, Bristol, "Engineering Aspects of Water Supply with special reference to the Bristol Area," R. W. Melvin, 7.15 p.m.

INSTITUTE OF BRITISH FOUNDRYMEN

Wed., Oct. 28th.—LONDON BRANCH : Waldorf Hotel, Aldwych, W.C.2, "Shell Moulding," A. Emmerson, 7.30 p.m.

INSTITUTE OF REFRIGERATION

Tues., Oct. 20th.—Storey's Gate, St. James's Park, London, S.W.1, "Insulation Testing," H. S. Hatfield and L. A. Smith, 5.30 p.m.

INSTITUTE OF ROAD TRANSPORT ENGINEERS

Wed., Oct. 21st.—NORTH-WEST CENTRE : The Victoria Hotel, Wigan, "The Port of Liverpool," D. Gilmour, 7.30 p.m.
Thurs., Oct. 22nd.—LONDON : The Royal Society of Arts, John Adam Street, London, W.C.2, "Filtration for Road Transport Vehicles," E. A. Stokes, 6.30 p.m.

INSTITUTE OF WELDING

Sat., Oct. 24th.—SOUTH LONDON BRANCH : Visit to G. A. Harvey and Co., Ltd., Greenwich.

INSTITUTION OF CHEMICAL ENGINEERS

Sat., Oct. 17th.—MIDLANDS BRANCH : The University, Edmund Street, Birmingham, "Some Aspects of Chemical Engineering in the Manufacture of Man-Made Fibres," W. G. Daroux, 3 p.m.

INSTITUTION OF CIVIL ENGINEERS

Tues., Oct. 20th.—Great George Street, Westminster, London, S.W.1, "The Measurement and Utilisation of the Water Resources of the Nile Basin," W. E. Hurst, 5.30 p.m.
Wed., Oct. 21st.—MIDLANDS ASSOCIATION : The College, Loughborough, Second Ordinary Meeting, 7 p.m.——NORTH-WESTERN ASSOCIATION : The County Hall, Preston, "The Design of Motorways," T. E. Hutton, 5.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

Mon., Oct. 19th.—Savoy Place, London, W.C.2, Discussion on "Television," to be opened by president.
Tues., Oct. 20th.—Savoy Place, London, W.C.2, Measurements Section, Chairman's Address, 5.30 p.m.——EAST MIDLAND CENTRE : Gas Showrooms, Nottingham, Informal Lecture on "Lightning Surges," R. H. Golde, 6.30 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND

Tues., Oct. 20th.—39, Elmbank Crescent, Glasgow, "Standard sation of Diesel-Electric Power Packs," J. C. Macfarlane, J. W. Macfarlane and W. I. Macfarlane, 6.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS

Wed., Oct. 21st.—Inst. of Mechanical Engineers, Storey's Gate, S.W.1, "Production of Steel Wagons," W. Vandy, 5.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS

To-day, Oct. 16th.—Storey's Gate, St. James's Park, London, S.W.1, General Meeting, Presidential Address by A. Roebuck, 5.30 p.m.
Fri., Oct. 23rd.—SOUTHERN BRANCH : The Brighton Technical College, "Trends in Industrial Power Engineering with Reference to Fuel Conservation," J. Fox, 7.30 p.m.

INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS

Tues., Nov. 10th.—Institution of Electrical Engineers, Savoy Place, London, W.C.2, "The Influence of Signal Imitation on the Design of V.F. Signalling Systems," S. Welch, 5 p.m.
Wed., Oct. 21st.—Conference Room, 4th Floor, Waterloo Bridge House, London, S.E.1, "Some Aspects of the Growth and Maintenance of the Telephone System," G. S. Berkeley, 5 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS

Thurs., Oct. 22nd.—Institution Meeting Hall, 11, Upper Belgrave Street, London, S.W.1, "Crane Gantry Girders for Steelworks," J. S. Terrington and J. M. Hawkes, 5.55 p.m.

JUNIOR INSTITUTION OF ENGINEERS

To-day, Oct. 16th.—Townsend House, Greycoat Place, London, S.W.1, "The Use of Wind Tunnels to Industry," D. H. Williams 7 p.m.
Fri., Oct. 23rd.—Townsend House, Greycoat Place, London, S.W.1, "Waste Heat Recovery as Applied to Diesel Engines," R. M. Tufnell, 7 p.m.

LIVERPOOL JOINT CHEMISTRY COMMITTEE

Wed., Oct. 21st.—Grosvenor Hotel, Chester, "Discovery and Development of an Oilfield," H. R. Lovely, 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS

To-day, Oct. 16th.—The Engineers' Club, Albert Square, Manchester, "The Formation and Prevention of Atmospheric Contamination in Factories," W. A. Attwood and W. B. Lawrie, 6.45 p.m.
Fri., Oct. 30th.—The Engineers' Club, Albert Square, Manchester, "Water Turbines and Their Applications," G. M. Hardman, 6.45 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

To-day, Oct. 16th.—The Literary and Philosophical Society, Newcastle upon Tyne, "Ship Model Correlation and Tank Wall Effect," E. V. Telfer, 6.15 p.m.

ROYAL METEOROLOGICAL SOCIETY

Wed., Oct. 21st.—49, Cromwell Road, London, S.W.7, "The Conditions for Dynamical Similarity of Motions of a Frictionless Perfect-gas Atmosphere," G. K. Batchelor, "A Quantitative Analysis of Large-scale Patterns with special regard to the Effect of Eddy Motion," F. A. Berson, "On the Theory of Large-scale Disturbances in a Two-dimensional Baroclinic Equivalent of the Atmosphere," P. D. Thompson, 5 p.m.

SHEFFIELD SOCIETY OF ENGINEERS AND METALLURGISTS

Mon., Oct. 19th.—The University Building, St. George's Square, Sheffield, "Control Valves for Direct Hydraulic Presses and the Application of the System to a 1000-ton Forging Press," F. H. Fowler, 7.30 p.m.

SOCIETY OF CHEMICAL INDUSTRY

Mon., Oct. 19th.—Chemical Society, Burlington House, Piccadilly, W.1, "Phosphating of Steel Prior to Painting," H. A. Holden, "Protective Qualities of Various Phosphate Coatings on Steel," J. F. Andrew, S. G. Clarke, E. E. Longhurst.

SOCIETY OF INSTRUMENT TECHNOLOGY

To-day, Oct. 16th.—Manson House, Portland Place, London, W.1, "Frequency Response Methods Applied to Large Servo-Mechanisms," J. R. D. Walker, 7 p.m.
Tues., Oct. 27th.—Manson House, Portland Place, London, W.1, "Static and Dynamic Performance of Sheathed Industrial Thermometers," A. R. Aikman, J. McMillan and A. W. Morrison, 7 p.m.

TELEVISION SOCIETY

Thurs., Oct. 22nd.—Cinematograph Exhibitors' Association, 164, Shaftesbury Avenue, London, W.C.2, "Flywheel Synchronising and Scanning Circuits," H. Fairhurst, 7 p.m.